

SELECTED  
 **WATER  
RESOURCES  
ABSTRACTS**



VOLUME 13, NUMBER 10  
MAY 15, 1980

W80-03301 -- W80-03600  
CODEN: SWRABW

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# **SELECTED WATER RESOURCES ABSTRACTS**

A semimonthly publication of the  
Office of Water Research and Technology  
U.S. Department of the Interior



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The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

SELECTED

**A**s the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

## FOREWORD

**S**electing Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

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**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of

several planned services of the Office of Water Research and Technology.

To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology  
U.S. Department of the Interior  
Washington, D.C. 20240

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### 02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

### 03 WATER SUPPLY AUGMENTATION AND CONSERVATION.

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

### 04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

### 05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

### 06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

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## ABSTRACT SOURCES

# SELECTED WATER RESOURCES ABSTRACTS

## 1. NATURE OF WATER

### 1A. Properties

#### PROCESS FOR CATALYTIC PHOTO-OXIDATION OF WATER

National Research Development Corp., London (England). (Assignee).  
A. Harriman, and G. Porter.

US Patent No 4,176,026, 12 p, 3 Fig, 3 Tab, 2 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1039, November 27, 1979.

Descriptors: \*Patents, \*Solar radiation, \*Oxidation, Energy conversion, Light, Water treatment, Oxygen, Chemical reactions, Manganese, Photo-oxidation, Chemical fuel.

The object of the invention is to provide a process by means of which visible light can be used to photo-oxidise water into oxygen and in which the electrons which are released from the water in such a process are captured by an electron acceptor to form a compound which acts as a store of energy and which may subsequently be used as, or converted to, a chemical fuel. The process comprises irradiating with light in the visible region of the spectrum a solution comprising water, a manganese (II) or manganese (III) complex of formula  $MnL$  wherein  $L$  is a phthalocyanine ligand, a 5, 10, 15, 20-tetraphenylporphyrin ligand or a 5, 10, 15, 20-tetraphenylpyrrolophyrin ligand, and a suitable electron acceptor. The process results in the oxidation of water into oxygen and the reduction of the electron acceptor. The reduced electron acceptor may be used as, or converted to, a chemical fuel. (Sinha-OEIS)  
W80-03440

#### VEGETATION AND NUTRIENT STATUS OF NORTHERN MICHIGAN FENS

Michigan Univ., Pellston. Biological Station.  
For primary bibliographic entry see Field 21.  
W80-03523

### 1B. Aqueous Solutions and Suspensions

#### THE EFFECT OF SALINITY ON GEOTHERMAL WELL PERFORMANCE

California Univ., Livermore. Lawrence Livermore Lab.  
For primary bibliographic entry see Field 8B.  
W80-03430

#### METHOD OF GENERATING HYDROGEN AND OXYGEN FROM WATER

Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (Assignee)  
H. Barnert, J. Divisek, and W. Faul.  
U.S. Patent No 4,175,013, 6 p, 1 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 988, No 3, p 692, November 20, 1979.

Descriptors: \*Patents, \*Chemical reactions, \*Electrolysis, Gases, Hydrogen, Oxygen, Electrolytes, Organic compounds.

A method of generating oxygen and hydrogen from water is described in which an acidic electrolyte containing formaldehyde is electrolyzed and produces oxygen and a gas which contains a low molecular-weight hydrocarbon. The low molecular-weight hydrocarbon is subjected to a catalytic conversion with water to produce synthesis gas consisting predominantly of hydrogen and carbon monoxide which are reacted to yield methanol. The methanol, in turn, is reacted to produce formaldehyde which is introduced into the electrolysis itself and hydrogen which is recovered. (Sinha-OEIS)  
W80-03550

## 2. WATER CYCLE

### 2A. General

#### HYDROLOGIC LAND USE CLASSIFICATION USING LANDSAT

Hydrologic Engineering Center, Davis, CA.  
For primary bibliographic entry see Field 7B.  
W80-03347

#### RESERVOIR STORAGE DETERMINATION BY COMPUTER SIMULATION OF FLOOD CONTROL AND CONSERVATION SYSTEMS

Hydrologic Engineering Center, Davis, CA.  
For primary bibliographic entry see Field 6A.  
W80-03348

#### DETERMINING PEAK-DISCHARGE FREQUENCIES IN AN URBANIZING WATERSHED-A CASE STUDY

Corps of Engineers, Detroit, MI. Detroit District. S. F. Daly, and J. Peters.  
Hydrologic Engineering Center, Davis, California.  
Technical Paper No 64, July 1979. 13 p, 12 Fig, 4 Tab, 12 Ref.

Descriptors: \*Urbanization, \*Urban hydrology, \*Peak discharge, \*Michigan, Hydrograph analysis, Frequency analysis, Frequency curves, Flood recurrence interval, Unit hydrographs, Watersheds(Basins), Analytical techniques, Analysis, Infiltration, Runoff, Rainfall-runoff relationships, Computer models, \*Red Run Drain(MI), Case study, Ungaged area, Impervious surfaces.

A case study was presented of a hydrologic investigation of the Red Run Drain-Lower Clinton River watershed, an area near Detroit, Michigan, that has undergone urbanization since the 1940s. The purpose of the study was to determine peak-discharge frequencies at gaged and ungaged locations for existing and future conditions. Population density was used as an indicator of urbanization in relationships defining unit hydrograph parameters and hydrologically significant impervious area. Input parameters for a single event rainfall-runoff simulation model (HEC-1) were developed to reflect watershed conditions in the years 1940, 1950, 1960, and 1975. The input parameters were verified by reconstructing observed flood events that occurred at these points in time. Sets of synthetic winter and summer storm hyetographs were input to HEC-1 to develop a series of curves for two gaging stations that relate peak discharge to magnitude of synthetic storm for each watershed condition. The curves were used to transform the series of recorded annual peak discharges at each gage to a stationary series that reflects 1975 watershed conditions. Discharge frequency estimates were then developed for ungaged locations using winter and summer synthetic storms that were assigned exceedance frequencies consistent with actual exceedance frequencies at the gaged locations. Projections of future population density were the basis for developing HEC-1 input parameters representing years 2000 and 2025 watershed conditions. Estimates of peak discharge-frequencies for the future conditions were made at the gaged and ungaged locations using the methods described above. (Humphreys-ISWS)  
W80-03349

#### FLOOD HYDROGRAPH AND PEAK FLOW FREQUENCY ANALYSIS

Hydrologic Engineering Center, Davis, CA.  
A. D. Feldman.  
Technical Paper No 62, March 1979. 19 p, 4 Fig, 1 Tab, 37 Ref.

Descriptors: \*Hydrograph analysis, \*Peak discharge, \*Watersheds(Basins), \*Floods, Analytical techniques, Hydrographs, Model studies, Frequency analysis, Streamflow forecasting, Flood frequency, Hydrologic systems, Runoff, Ungaged areas.

This paper addressed the practical state of the art of techniques to predict flood peaks and their

associated frequency of occurrence, and techniques for predicting critical flood hydrographs (or series of hydrographs) and their frequencies of occurrence. Statistical relationships, empirical equations, and watershed models were investigated as means for predicting the peak discharges and flood hydrographs. In general, the larger or more complex the drainage system becomes, the more the analysis shifts from predicting peaks to predicting the whole hydrograph. The techniques addressed in this paper were separated into the following categories: (1) frequency analysis of historical streamflows, (2) statistical equations, (3) empirical formulae, (4) single event watershed models, and (5) continuous watershed models. (Humphreys-ISWS)  
W80-03350

#### TESTING OF SEVERAL RUNOFF MODELS ON AN URBAN WATERSHED

Hydrologic Engineering Center, Davis, CA.  
J. Abbott.  
Technical Paper No 59, October 1978. 50 p, 15 Fig, 11 Tab, 15 Ref.

Descriptors: \*Urban runoff, \*Model studies, \*California, \*Watersheds(Basins), Computer models, Storm runoff, Routing, Hydrographs, Discharge(Water), Storm water, Management, Calibrations, Surface runoff, Hydrologic aspects, Hydrology, Unit hydrographs, Monthly, Analytical techniques, Castro Valley Watershed(CA), Urban watersheds, Daily runoff.

Six models, plus two variants of one and a variant of another, were tested with the objective of making a preliminary evaluation of their relative capabilities, accuracies, and ease of application. For four of the models, plus two variants of one of them, the primary performance criterion was the degree to which simulated values matched observed daily and monthly runoff volumes for the 5.5-square mile Castro Valley Watershed near Oakland, California. In addition, tests were performed for several individual runoff events for all six models. The results showed that each model could be calibrated on a single set of data and verified with acceptable accuracy on a different data set. The ease of application was decidedly different for all models, due to the differing level of detail in input data required. Going from the simplest to most difficult to apply, the continuous models rank as follows: STORM, HEC-1C, SSARR, and HSP. Similar ranking of the single-event models is: HEC-1, SWMM, and MITCAT. Also, a recent capability added to the STORM model (i.e., SCS procedures for computing runoff and routing) produced more accurate results than the coefficient method of computing quantity of runoff incorporated in the original version of STORM. These limited tests were not intended to serve as a basis for comparison of the accuracy of the various models. However, they did show that the more complex models did not produce better results than the simple models for the Castro Valley Watershed data. (Humphreys-ISWS)  
W80-03352

#### IZING FLOOD CONTROL RESERVOIR SYSTEMS BY SYSTEMS ANALYSIS

Hydrologic Engineering Center, Davis, CA.  
For primary bibliographic entry see Field 6A.  
W80-03353

#### LAND-USE AND UPLAND WATER RESOURCES IN BRITAIN-A STRATEGIC LOOK

Institute of Hydrology, Wallingford (England). I. R. Calder, and M. D. Newson.  
Water Resources Bulletin, Vol 15, No 6, p 1628-1639, December 1979. 4 Fig, 3 Tab, 41 Ref.

Descriptors: \*Forest watersheds, \*Rainfall disposition, \*Interception, \*Water yield, Runoff, Reservoirs, Water supply, Water resources, Evaporation, Evapotranspiration, Watersheds(Basins), Forests, Vegetation establishment, Land use, On-site investigations, Mathematical models, Model studies, Hydrology, \*England.

Recent results from the Institute of Hydrology's hydrometeorological and hydrological studies on

## Field 2—WATER CYCLE

### Group 2A—General

water use by forest and grassland confirm earlier predictions of a reduction in water yields following afforestation. This reduction is due primarily to the increased interception losses from forests. This paper showed how the water yield from uplands is related to the relative proportions of land under forest and hill farming, and estimated how water yields will change if a greater proportion of hill land is afforested. (Sims-ISWS)  
W80-03363

**SCIENTIFIC ASPECTS OF THE 1975-76 DROUGHT IN ENGLAND AND WALES.**  
For primary bibliographic entry see Field 2E.  
W80-03444

**SOME DETAILED WATER BALANCE STUDIES OF RESEARCH CATCHMENTS.**  
Institute of Hydrology, Wallingford (England).  
R. T. Clarke, and M. D. Newson.  
In: Scientific Aspects of the 1975-76 Drought in England and Wales; Proceedings of a Royal Society Discussion Meeting held on October 28, 1977. p 21-42, 1978. 6 Fig, 7 Tab.

Descriptors: \*Demonstration watershed, \*Water balance, \*Water yield, \*Droughts, Forest watersheds, Agricultural watersheds, On-site investigations, Data collections, Water levels, Vegetation effects, Groundwater, Soil moisture, Evaporation, Rainfall, Watersheds(Basins), Hydrology, Foreign research, Land use, Precipitation(Atmospheric), Analysis, Streamflow, Aquifers, Discharge(Water), \*England, \*Wales.

Aspects of the water balance during the drought period 1975-76 were reported for the Institute of Hydrology's experimental catchments in Cumbria, East Anglia, the Thames Valley, and upland Wales. Summer (April-September) and winter (October-March) totals of precipitation, streamflow, and potential evaporation during the drought were compared with mean values for seasons preceding it; where soil moisture was measured by neutron probe, losses from actual evaporation were also compared. Yield dropped proportionately less in relation to rainfall where catchments contained appreciable storage, such as the Cam catchment in East Anglia with its chalk-glacial drift aquifer, or the Wye and Severn catchments in upland Wales which contain storage areas of peat underlain by glacial drift. The stream draining the Oxford clay of the Ray catchment in the Thames valley, on the other hand, dried up entirely in the second summer of the drought. The paper suggested that the comparison of water yields from the Wye and Severn catchments, which are under hill pasture and coniferous forest respectively, gives results which have considerable bearing on the future management of water resources from upland areas when the aim of management is to maintain supplies of water even during periods of drought as extreme as the years 1975-76. The effect on reservoir operation of neglecting to allow for change in land use is illustrated by a hypothetical example using an artificial 30-year streamflow sequence containing a drought year with very long return period. (See also W80-03444) (Humphreys-ISWS)  
W80-03446

**THE EFFECTS OF DROUGHT ON THE RIVER SYSTEMS.**  
Birmingham Univ. (England). Dept. of Water Engineering.  
M. J. Hamlin, and C. E. Wright.  
In: Scientific Aspects of the 1975-76 Drought in England and Wales; Proceedings of a Royal Society Discussion Meeting held on October 28, 1977. p 69-96, 1978. 10 Fig, 9 Tab, 15 Ref.

Descriptors: \*Droughts, \*River systems, \*Watersheds(Basins), \*Mathematical models, Runoff, Rainfall, Streamflow, Streamflow forecasting, Statistical methods, Analytical techniques, Rivers, Evaporation, Foreign research, Data collections, Frequency analysis, Hydrographs, Low-flow frequency, Low flow, Reservoir storage, Moisture deficit, Model studies, \*England, \*Wales, Watershed characteristics.

The drought of 1975-76 had a significant effect on the river systems of England and Wales and will be used in water resources design for many years. It is therefore important to recognize that for the river flows it was not uniformly severe. Further, for many purposes, the duration of the low flow is at least as important as its severity. As an example, for the river Thames at Teddington it was only for periods of one and two months that the flow in 1976 was lower than that in 1921. The paper reviewed the conditions that give rise to low flows in rivers, compared a representative set of low flow records, commented on criteria that were used to reduce the effect of the drought on the quantity and quality of river flows, and suggested methods by which the management of rivers in time of drought might be improved. What is necessary is to present the information in terms that show clearly the consequences of particular courses of action given clearly stated probabilities of future rainfall or river flows. This will enable logical decisions to be taken. This may be attempted in one of three ways: the use of data generation techniques, the use of rainfall statistics where these are easier to obtain than adequate river flow data, or the use of flow records where they are of sufficient length to permit realistic statistical analysis. The use of rainfall statistics, if it is possible to derive a satisfactory rainfall runoff model, gives the most promising method and warrants further research and development. (See also W80-03444) (Humphreys-ISWS)  
W80-03448

**PLANNING FOR DEVELOPMENT OF GROUNDWATER AND SURFACE WATER RESOURCES.**  
Central Water Planning Unit, Reading (England).  
For primary bibliographic entry see Field 2E.  
W80-03450

**A SYSTEMS MODEL OF STREAM FLOW AND WATER QUALITY IN THE BEDFORD-OUSE RIVER-1. STREAM FLOW MODELLING.**  
Institute of Hydrology, Wallingford (England).  
For primary bibliographic entry see Field 2E.  
W80-03456

**THE APPLICATION OF HYDROLOGIC MODELS TO SMALL WATERSHEDS HAVING MILD TOPOGRAPHY.**  
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 2B.  
W80-03469

**CURRENT SUBSURFACE INTRUSION OF MEDITERRANEAN SEAWATER-A POSSIBLE SOURCE OF GROUNDWATER SALINITY IN THE RIFT VALLEY SYSTEM, ISRAEL.**  
Geological Survey of Israel, Jerusalem.  
U. Kafri, and A. Arad.  
Journal of Hydrology, Vol 44, No 3/4, p 267-287, December 1979. 8 Fig, 2 Tab, 42 Ref.

Descriptors: \*Saline water, \*Groundwater resources, \*Chemical properties, \*Saline water-freshwater interfaces, \*Geohydrologic units, Groundwater, Aquifer systems, Isotope studies, Mixing, Geochemistry, Paleohydrology, Geologic history, Sea water, Saline water intrusion, \*Galilee(Israel), \*Israel, Flushing.

Various theories have been put forward regarding the salination mechanism in the Jordan-Dead Sea Rift Valley and its branching valleys. None of these has suggested current subsurface seawater penetration to the internally drained Judea Group aquifer as a part of the system. The hydrogeological configuration is a combination of a low water table and a rather low groundwater divide, resulting in a shallow sea-fresh water interface. In most of the area the interface is expected to be situated above the base of the aquifer. As a result, current seawater intrusion is possible across the groundwater divide through the Yizre'el and Beersheva valleys which dissect Israel and connect the Mediterranean and the Jordan-Dead Sea Rift Valley. The model suggested herein is in accordance with,

or cannot be rejected on the basis of, the chemistry and isotope composition of the saline waters. In the highly flushed aquifers of the internal valleys, brackish water with marine affinity suggests current infiltration of seawater. This mechanism is additional to other sources, such as deep seated, highly concentrated brines and entrapped fossil seawater, all of which are diluted by the flow of cyclic freshwaters. (Adams-ISWS)  
W80-03472

**THE PALEOHYDROLOGY OF SOUTHERN ISRAEL AND ITS INFLUENCE ON THE FLUSHING OF THE KURNUB AND 'ARAD GROUPS (LOWER CRETACEOUS AND JURASSIC).**  
Ben Gurion Univ. of the Negev, Beersheba (Israel). Inst. of Research.  
A. Issar.  
Journal of Hydrology, Vol 44, No 3/4, p 289-303, December 1979. 7 Fig, 23 Ref.

Descriptors: \*Saline water, \*Aquifer systems, \*Chemical properties, \*Geohydrologic units, \*Paleohydrology, Groundwater, Groundwater resources, Isotope studies, Mixing, Geochemistry, Geologic history, \*Negev(Israel), \*Israel, Flushing.

The ionic composition, stable isotope, and total salinity pattern of waters from the aquifer of the Kurnub and 'Arad groups (Lower Cretaceous-Jurassic) suggest that these waters replaced previous formation brines. The hydrologic regime which caused the flushing is the same as that which filled the Kurnub Group aquifer ('Upper Nubian Sandstone') of the central and southern Negev. Infiltration took place during humid phases of the Pleistocene, through outcrops along the igneous massif of the southern Sinai. Northward, subsurface flow was made possible mainly by the opening of outlet zones along the regional faults accompanying the Syrian-African rift system. The layers beneath the Coastal Plain were not flushed as no outlet was available due to the deep burial of these layers under a thick impermeable cover of the Shefela and Saqiye groups. Alternative models by other authors (Mesozoic and Recent flushing) are briefly discussed. (Adams-ISWS)  
W80-03473

**HYDROMETEOROLOGICAL MODEL FOR STREAMFLOW PREDICTION.**  
Geological Survey, Tacoma, WA. Water Resources Div.  
W. V. Tangborn.  
Available from: OFSS U.S. Geological Survey Box 25425, Federal Center Denver, CO microfiche \$3.50 paper copy \$12.00. Geological Survey open file report 79-741, 1979. 88 p, 11 Fig, 7 Tab, 3 Ref, 9 Append.

Descriptors: \*Streamflow forecasting, \*Model studies, \*Hydrology, \*Meteorology, \*Washington, Hydrologic data, Methodology, On-site data collections, Water storage, River basins, Rainfall-runoff relationships, Snowmelt, \*North Cascades region(Wash).

The hydrometeorological model described in this manual was developed to predict seasonal streamflow from water in storage in a basin using streamflow and precipitation data. The model, as described, applies specifically to the Skokomish, Nisqually, and Cowlitz Rivers, in Washington State, and more generally to streams in other regions that derive seasonal runoff from melting snow. Thus the techniques demonstrated for these three drainage basins can be used as a guide for applying this method to other streams. Input to the computer program consists of daily averages of gaged runoff of these streams, and daily values of precipitation collected at Longmire, Kid Valley, and Cushman Dam. Predictions are based on estimates of the absolute storage of water, predominately as snow: storage is approximately equal to basin precipitation less observed runoff. A pre-forecast test season is used to revise the storage estimate and improve the prediction accuracy. To obtain maximum prediction accuracy for operational applications with this model, a systematic evaluation of

## WATER CYCLE—Field 2

### Precipitation—Group 2B

several hydrologic and meteorologic variables is first necessary. Six input options to the computer program that control prediction accuracy are developed and demonstrated. Predictions of streamflow can be made at any time and for any length of season, although accuracy is usually poor for early-season predictions (before December 1) or for short seasons (less than 15 days). The coefficient of prediction (CP), the chief measure of accuracy used in this manual, approaches zero during the late autumn and early winter seasons and reaches a maximum of about 0.85 during the spring snowmelt season. (Kosco-USGS) W80-03487

#### WATER RESOURCES OF THE NISQUALLY LAKE AREA, PIERCE COUNTY, WASHINGTON

Geological Survey, Tacoma, WA. Water Resources Div. H. E. Pearson, and N. P. Dion. Available from the National Technical Information Service, Springfield, VA 22161 as PB-300 953. Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-101, May 1979. 34 p, 6 Fig, 7 Tab, 20 Ref.

Descriptors: \*Groundwater resources, \*Surface-groundwater relationships, \*Model studies, \*Groundwater availability, \*Streams fisheries, Chemical analysis, Water temperature, Data collections, Discharge measurements, Hydrologic cycle, Glacial drift, Till, Water quality, Drilling, Test wells, Bathymetry, Washington, \*Nisqually Lake area (Wash.), \*Pierce County (WA), Fort Lewis, Nisqually Indian Reservation.

This report presents data on the water resources of an area within, and adjacent to a part of the Fort Lewis Military Reservation, Wash., that prior to 1917 was included in the Nisqually Indian Reservation. The only surface-water bodies of significance in the study area are Muck Creek and Nisqually Lake. A large spring also is in the study area. Development or diversion of Muck Creek near its mouth would provide sufficient water for a small to medium sized fish-rearing facility. The highest water temperature recorded during the 25 months of data collection was 14C in August 1977 for Muck Creek. Nisqually Lake has a surface area of about 89 acres and is shallow with a flat bottom. Species of warm-water fish are probably best suited for the lake. Ground water occurs in unconsolidated glacial drift or outwash of gravel, sand, silt, and clay. Drilling of test wells is required to provide more reliable data on yields of ground water. (Kosco-USGS) W80-03494

#### BIOGEOGRAPHICAL CONSIDERATIONS OF COLONIZATION OF THE LOWER TILDEMI VALLEY IN THE SECOND MILLENNIUM B.C., Cape Town Univ. (South Africa). Dept. of Archaeology.

A. B. Smith. Journal of Arid Environments, Vol 2, No 4, p 355-361, Dec 1979. 2 Fig, 25 Ref.

Descriptors: \*Biogeography, \*Migrations, \*Sahara, \*Mali, \*Paleoclimatology, History, Social aspects, Rural sociology, Model studies, Droughts, Water supply, Africa.

Pastoral peoples of the Saharan and Sahel zones of West Africa have been subjected to fluctuating environmental conditions since the introduction of domestic animals into North Africa c. 7000 B.P. The present paper attempts to create a dynamic model of the palaeoenvironmental situation in the Sahel and, from archaeological data excavated in the Tildemi Valley, Mali, offers an example of human response to these fluctuating conditions which illustrated how these people responded to drought by always moving south into better-watered areas. Expansion of the pastoral way of life in the Sahara before 6500 B.P. is postulated to have been tied closely to annual precipitation and evapotranspiration. Increasing instability in this dynamic equilibrium by 4500 B.P., however, is thought to have precipitated the decision to migrate to where sufficient water and pasturage

would be available. Colonization is further postulated to have been due to a number of other coincident factors, including a gradual southward movement of the savanna zone and the concomitant retreat of the Tsetse belt. (Tickes-Arizona) W80-03553

### 2B. Precipitation

TEXAS HIPLEX INTERIM PROGRESS REPORT FOR APRIL 1 - SEPTEMBER 30, 1979. Texas Dept. of Water Resources, Austin. Planning and Development Div. Report No LP-110, December 1979 Prepared for the Bureau of Reclamation, Office of Atmospheric Resources Management. 138 p, 10 Fig, 14 Tab, 2 Append.

Descriptors: \*Weather modification, \*Cloud seeding, \*Texas, \*Precipitation (Atmospheric), Cloud physics, Climatology, Satellites (Artificial), Data collections, Climatic data, Artificial precipitation, Synoptic analysis, Meteorological data, Weather data, High Plains Cooperative Program.

An evaluation of the 1979 operation season is presented along with a continued description of 1976-1978 operations for the Texas HIPLEX Project (High Plains Cooperative Program). The project, begun in 1974 by the Bureau of Reclamation Office of Atmospheric Resources Management and the Texas Water Development Board, is designed to establish a verified, working technology and operation management framework capable of producing additional rain from cumulus clouds in the semiarid Plains States. Three field research sites are being used and the one evaluated here is the Big Spring-Snyder area of Texas. Cloud and precipitation processes associated with natural and seeded clouds in the area are being studied. Progress reports on mesoscale data evaluation are given along with synoptic climatology development, satellite radiance data analysis, radar data analysis and interpretation, and cloud-sampling with seeding operations. Mesoscale data for 1978 are similar to 1976 and 1977 data. The major parameter determining suitable cloud seeding environment in the area is moisture. A comprehensive satellite imagery and radiance data analysis is being prepared for 1976 through 1978. Digitized M-33 radar tapes data are also being analyzed for later combination with previous years results. (Seigler-IPA) W80-03319

#### TEXAS HIPLEX 1979 FIELD OPERATIONS SUMMARY

Texas Dept. of Water Resources, Austin. W. O. Alexander, and R. F. Riggio. Report No LP-112, January 1980. 398 p, 5 Tab, 1 Append.

Descriptors: \*Texas, \*Weather modification, \*Weather data, \*Cloud seeding, Cloud physics, Meteorology, Precipitation (Atmospheric), Rain, Weather forecasting, Aircraft, Application equipment, High Plains Cooperative Program (HIPLEX).

Daily summaries of 1979 Texas HIPLEX (High Plains Cooperative Program) Field Program are provided for each day from May 21 through July 20 in chronological order. Summary tables are presented for the 1979 Texas HIPLEX field season, aircraft flight operations, and all Texas HIPLEX related cloud-seeding activities. Information given includes when and where cloud sampling and/or seeding was done and when aircraft, radar, rawinsonde, and special surface data were collected. Daily weather summaries are given for the period along with surface and airborne weather observations and equipment status. With each daily weather summary is a log of observed weather conditions generally made hourly from 0800 to 1700 CDT from the Big Spring Meteorological Facility. Aircraft used in the program were two Navajos, one pressurized for cloud seeding, and an Aztec. Silver iodide flares were used for all cloud seeding. Other information given includes an equipment status report and rawinsonde and precipitation tables. (Seigler-IPA)

W80-03320

LAND-USE AND UPLAND WATER RESOURCES IN BRITAIN—A STRATEGIC LOOK, Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2A. W80-03363

#### PROBLEMS IN WEIGHTING OF HYETOGRAPHS

Pennsylvania State Univ., University Park. Dept. of Civil Engineering. G. Aron, J. C. Collins, and D. F. Kibler. Water Resources Bulletin, Vol 15, No 6, p 1556-1564, December 1979. 3 Fig, 2 Tab, 4 Ref.

Descriptors: \*Hyetographs, \*Isohyets, \*Storms, Precipitation (Atmospheric), Weight, Rain gages, Watersheds (Basins), Floods, Rain, Flood flow, Storm runoff modeling, \*Hyetograph weighting, Storm patterns, Rainfall volumes, Precipitation measurement, Thiessen diagram, Isohyetal maps.

The conventional weighting factor application to hyetograph ordinates resulted in artificially attenuated storm patterns. A modified weighting procedure was suggested that allows adjustments in the storm timing, peak intensity, and volume but conserves the storm pattern observed at the rain gage nearest to the watershed point of interest. The systematic underestimation of peak flood flows, which resulted from conventional hyetograph weighting, was avoided by conserving the hyetograph shape from the rain gage nearest to any subarea of a modeled watershed and by merely applying weighting factors to the rainfall volumes and temporal center of gravity of several hyetographs. (Roberts-ISWS) W80-03365

#### DETERMINING OVERWATER PRECIPITATION FROM OVERLAND DATA: THE METHODOLOGICAL CONTROVERSY ANALYZED, National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.

S. J. Bolsenga. Journal of Great Lakes Research Vol 5, No 3-4, p 301-311, 1979. 3 Fig, 6 Tab, 27 Ref.

Descriptors: \*Great Lakes, \*Precipitation gages, \*Precipitation atmospheric, Snowfall, Rainfall, Limnology, Radar, Remote sensing, Weather patterns, Instrumentation, Towers, Islands, Water levels, Hydrographs, Lakes.

Various methods for measuring or estimating overwater precipitation are examined to determine the usefulness and accuracy of the techniques used. Knowledge of the relationship of land precipitation to lake precipitation is critical in determining overwater precipitation since actual gage measurements of lake precipitation are practically nonexistent. In the past overwater precipitation for large lakes has been estimated by measuring precipitation with gages on islands, towers, or other on lake structures. These measurements are then compared to shoreline measurements and lake/land precipitation ratios are calculated. The ratios are then used to estimate lake precipitation from shore precipitation measurements. However, the validity of such results are now being questioned due to seasonal land lake/land precipitation ratio changes and precipitation gage inaccuracies. Gage inaccuracies or undercatchments result from shielded or unshielded conditions, wind velocity and direction, and differing precipitation forms such as rain, snow, or sleet. Recent tests with accurate gage measurements however, show that lake/land differences are small and monthly differences are statistically insignificant. One solution to gage accuracy problems is the use of radar to measure overwater precipitation. In tests, ratios obtained with radar agree well with actual field data. Suggestions are given for designing a viable accurate method of overwater precipitation determination by initially using radar to determine precipitation ratios. Revised ratios may be needed seasonally or as any change occurs which would alter ratio values. (Seigler-IPA)

## Field 2—WATER CYCLE

### Group 2B—Precipitation

W80-03392

**METEOROLOGICAL ASPECTS OF THE 1975-76 DROUGHT.**  
For primary bibliographic entry see Field 2E.  
W80-03445

**THE APPLICATION OF HYDROLOGIC MODELS TO SMALL WATERSHEDS HAVING MILD TOPOGRAPHY.**  
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.  
E. C. Dickey, J. K. Mitchell, and J. N. Scarborough.  
Water Resources Bulletin, Vol 15, No 6, p 1753-1769, December 1979. 5 Fig, 5 Tab, 12 Ref.

**Descriptors:** \*Model studies, \*Hydrograph analysis, \*Illinois, \*Small watersheds, Watersheds(Basins), Hydrology, Simulation analysis, Topography, Shape, Rainfall, Storms, \*Hydrologic modeling, SCS model, Hydrograph simulation, Mild topography, Rainfall events, Time rate distribution, Empirical relationships.

This paper evaluated the applicability of hydrologic models described by L.F. Huggins and the Soil Conservation Service to small watersheds by comparing the simulated and actual hydrograph for both gaged and ungaged situations. The annual maximum rainfall events plus storms exceeding 2.5 inches from 25 years of rainfall and runoff data for two small watersheds were selected for the model evaluations. Simulated and actual hydrographs were compared using a parameter that contained volume, peak, and shape factors. One-half of the selected storms were used to calibrate the models. For both models, there were no significant differences between the simulated and actual runoff volumes and peak runoff rates. Parameters obtained during the calibration process and relationships developed to estimate antecedent moisture and to modify tabulated runoff curve numbers were used to simulate the runoff hydrograph from the remaining storms. These remaining storms or test storms were simulated only once in order to imitate an ungaged situation. In general, both the Huggins and Soil Conservation Service models performed similarly on the test storms, but the level of model performance was lower than that for the calibration storms. (Roberts-ISWS)  
W80-03469

**A HYDROLOGICAL ANALYSIS OF EAST AUSTRALIAN FLOODS USING NIMBUS-5 ELECTRICALLY SCANNING RADIOMETER DATA.**  
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.  
For primary bibliographic entry see Field 7B.  
W80-03474

**RECORD TORRENTIAL RAINSTORMS ON THE ISLAND OF HAWAII, JANUARY-FEBRUARY 1979.**  
Mauna Loa Observatory, Hilo, HI.  
R. S. Cram, and H. R. Tatum.  
Monthly Weather Review, Vol 107, No 12, p 1653-1662, December 1979. 5 Fig, 4 Tab, 8 Ref.

**Descriptors:** \*Rainfall, \*Excessive precipitation, \*Precipitation(Atmospheric), \*Hawaii, Floods, Flash floods, Storms, Tropical regions, Islands, Precipitation intensity, Weather, Climatology, Meteorology, Torrential rainstorms.

The heaviest and most extensive rainstorms in the history of weather records on the island of Hawaii occurred during the first two months of 1979. Nearly every rainfall record kept by the National Weather Service from the 45 min total through the monthly and two monthly totals was exceeded during January and February 1979. Only twice in the 90-year history of weather records at Hilo have rainfalls of similar magnitude occurred. The most significant characteristic of the 1979 storms is that the record rainfall was produced from warm clouds; clouds whose temperature is everywhere greater than 0C. The February 1979 storm produced rainfalls of 78.2 mm in 1 h and 566.4 mm in

24 h at Hilo from storm clouds with tops below the freezing level. Such rainfall amounts and rates are customarily believed to occur only during thunderstorms, where the cloud tops extend considerably above the freezing level. Thunderstorm activity was absent during the 1979 rainstorms. An account of the January and February 1979 storms and a survey of past record rainfalls on the island of Hawaii were presented. (Sims-ISWS)  
W80-03475

**A DISTANT READING RAINGAUGE.**  
Meteorological Office, Poona (India). Instruments Div.  
For primary bibliographic entry see Field 7B.  
W80-03476

**VERY LARGE FLOODS IN THE BRAHMAPUTRA RIVER IN AUGUST 1962, PART I: SYNOPSIS ASPECTS.**  
Observatory, New Delhi (India).  
C. Ramaswamy, and V. S. Rao.  
Mausam, Vol 30, No 1, p 9-20, January 1979. 10 Fig, 3 Tab, 10 Ref.

**Descriptors:** \*Floods, \*Rainfall, \*Monsoons, \*Rivers, Precipitation(Atmospheric), Excessive precipitation, Precipitation excess, Runoff, Watersheds(Basins), Winds, Air circulation, Weather, Meteorology, \*India, \*Brahmaputra River(India).

The large scale synoptic situations from the time of onset of the southwest monsoon to the end of August in 1962 over the catchment of the Brahmaputra (including that of the Tsangpo) were studied using the synoptic charts prepared in India and those published by the Japan Meteorological Agency. Time-sections of the upper winds over Gauhati (26 deg 11 min N, 91 deg 45 min E) and of the heavy rainfall at the India Meteorological Department stations over the Brahmaputra basin were also studied for all important situations. It was shown that the lee-vortices which develop to the southeast of the Tibetan plateau play a very important role in the occurrence of very heavy rainfall over and near Pasighat (28 deg 06 min N, 95 deg 23 min E) in the extreme northeast of Arunachal Pradesh and over the eastern half of the Tsangpo. The conclusion was drawn that frequent and exceptionally heavy rainfall over these areas was predominantly responsible for the phenomenal discharge of the Brahmaputra at Pandu near Gauhati on 24 August 1962. The genesis of the lee-vortices to the southeast of the Tibetan plateau was also discussed. The need for the development of synoptic climatology of the above-mentioned area, with special reference to weather over the Brahmaputra basin, was pointed out. (Sims-ISWS)  
W80-03598

### 2C. Snow, Ice, and Frost

**ICE THICKNESS INDICATOR.**  
D. W. Iwanicki.  
US Patent No 4,175,512, 7 p, 8 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 868, November 27, 1979.

**Descriptors:** \*Patents, \*Ice, \*Water types, Ice cover, Safety, Measurement, Iced lakes, Equipment, Ice thickness.

An ice thickness indicator is placed at the surface of a body of water by floats. It provides a means to indicate whether the water has frozen to a predetermined thickness. The device includes an enclosed chamber which may be filled with water. The chamber is expandable by means of a movable member which partly defines the chamber. The movable member is located below the surface of the water and is connected to an upwardly extending indicator which displays different indications, depending on the relative position of the movable member. As the body of water in which the device is immersed freezes, the water within the expandable chamber also freezes and expands to cause movement of the movable member and operate the indicator. (Sinha-OEIS)

W80-03513

### 2D. Evaporation and Transpiration

**AN IMPROVED WEIGHING LYSIMETER FACILITY FOR CITRUS EVAPOTRANSPIRATION STUDIES.**  
Soil and Irrigation Research Inst., Pretoria (South Africa).  
G. C. Green, and W. Bruwer.  
Water SA, Vol 5, No 4, p 189-195, October 1979. 6 Fig, 7 Ref.

**Descriptors:** \*Lysimeters, \*Evapotranspiration, \*Citrus fruits, \*Water requirements, Moisture uptake, Water utilization, Transpiration, Climatology, Evaporation, Photosynthesis, Soil water movement, Water loss, Diurnal, Orchards, Plant groupings, South Africa.

Three prototype lysimeters installed in a block of Valencia trees, planted in 1963, were used to make detailed and consistent evapotranspiration (ET) measurements for the study of seasonal and daily citrus water relations. All lysimeters contained a single tree for a total mass of approximately 50 tons. The first lysimeter (C) was installed in 1970 and the other two (A and B) were installed in 1972. The steel lysimeter tanks for A and B were contained in concrete-lined pits. To prevent rusting the inner tank surfaces were coated with fiberglass. Some deficiencies in the tank construction were noted such as tank wall bulges. In 1975 an improved measuring system was installed and all three lysimeters were equipped with commercially obtainable precision load cells with a nominal accuracy of 0.02%. Three separate calibration runs were made with one run producing test masses of undispersed accuracy. The lysimeters surpassed general performance expectations with a sensitivity resolution of 2 kg the equivalent of 0.15mm of water over the 13.4 sq m surface area. The lysimeters also showed a good degree of uniformity in ET response. Daily ET totals can be measured within a 10% accuracy in winter and a 3% accuracy in summer. These accurate direct measurements of diurnal transpiration can be used to model the mechanism of water uptake and flow in citrus trees given the high transpiration rates of summer. (Seigler-IPA)  
W80-03325

**PHREATOPHYTE EVAPOTRANSPIRATION AND ITS POTENTIAL REDUCTION WITHOUT ERADICATION.**  
California Univ., Davis. Dept. of Land, Air and Water Resources.  
D. C. Davenport, J. E. Anderson, L. W. Gay, B. E. Kynard, and E. K. Bonde.  
Water Resources Bulletin, Vol 15, No 5, p 1293-1300, October 1979. 21 Ref. OWRT-C-6030 (5235)(5).

**Descriptors:** \*Antitranspirants, \*Evapotranspiration, \*Phreatophytes, Groundwater, Water conservation, Wildlife habitats, Energy budget, Tamarisk, Lysimeters, Stomata, Riparian water loss, Balance of nature, \*Chemical eradication, Bowen ratio, Foliage, Spray adherence, Nontoxic antitranspirant, Potential eradication, Riparian phreatophytic vegetation.

The continuous availability of groundwater to riparian phreatophytic vegetation results in large evapotranspiration losses in summer. Chemical or physical eradication of this vegetation has undesirable environmental effects. Spraying phreatophyte foliage with a nontoxic antitranspirant may reduce transpiration without eradication. Transpiration rate per unit leaf area is similar for several phreatophyte species, but evapotranspiration per unit land area of phreatophytes depends more on stand density than species. The mean for saltcedar evapotranspiration in June was 8.1 mm/day measured by Bowen ratio, compared with 7.9 mm by lysimeters. Growth-retardants reduced transpiration by over 50% in laboratory tests where foliage was thoroughly sprayed. In the field, antitranspirant sprayed by a back-pack mistblower reduced evapotranspiration by 20-35% initially and by 10% after

Streamflow and Runoff—Group 2E

one month. High cost and spraying difficulties precluded use in 1979. (Roberts-ISWS) W80-03442

**AN ELECTRICAL CONDUCTANCE METHOD FOR DETERMINING CONDENSATION AND EVAPORATION PROCESSES IN ARID SOILS WITH HIGH SPATIAL RESOLUTION.**  
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Hanover (Germany, F. R.). Inst fuer Strahlenbiologie.  
C. Bunnberg, and W. Kuhn.  
Soil Science, Vol 129, No 1, p 58-66, January 1980. 8 Fig, 21 Ref.

Descriptors: \*Electrical conductance, \*Condensation, \*Evaporation, \*Arid climates, Soil moisture, Laboratory tests, Moisture content, Instrumentation, Soil density, Soil temperature, Dew, Spatial resolution.

This paper described a new instrument developed to measure moisture movements as a result of condensation and evaporation processes in the upper soil layers in laboratory and field experiments. It is based on the well-known method of relating the moisture content of a soil to its electrical conductance. The high spatial resolution of 2 millimeters and the high sensitivity, especially in the dry range, make it a valuable tool for condensation and evaporation studies during the dry season of arid and semi-arid climates, as well as for soil physical investigations of water vapor diffusion. A number of laboratory tests demonstrate the performance of the instrument. (Visocky-ISWS) W80-03470

**EVAPOTRANSPIRATION FROM AN ARID ZONE PLANT COMMUNITY.**  
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
T. W. Sammis, and L. W. Gay.  
Journal of Arid Environments, Vol 2, No 4, p 313-321, Dec 1979. 5 Fig, 15 Ref.

Descriptors: \*Evapotranspiration, \*Water loss, \*Desert plants, \*Creosotebush, \*Model studies, \*Desert plants, Plant communities, Lysimeters, Soil-water-plant relationships, Water budget, Southwest U.S.

Total water loss was measured in two ways in a creosotebush community near Tucson, Arizona, with the specific objectives of: (1) measuring evapotranspiration from a typical stand, (2) evaluating the relative importance of the transpiration and evaporation components, and (3) testing and refining a simple diffusion model for estimating transpiration. Primary measurements made through the entire year with a weighing lysimeter at the US/IBP Desert Biome Silverbell Validation Site near Tucson, were used in the water budget method to evaluate evaporation from bare soil plots, and evapotranspiration from a creosotebush community. Additional measurements were made of soil, plant, and climatological data needed to model the transpiration rate from the lysimeter plant and from the surrounding stand. Water losses were found to closely approximate measured precipitation over the year long period, with total losses being 259 mm from the lysimeter, 242 mm from the adjacent bare plots. Transpiration losses estimated from water budgets of bare and vegetated plots were in reasonable agreement with estimates obtained from a simple canopy diffusion model. It was concluded that transpiration losses were a small portion of the total ET due to the high resistance and small leaf area index of the creosotebush canopy, and attempts to control ET by controlling creosotebush or similar desert vegetation will be ineffective. (Tikes-Arizona) W80-03548

## 2E. Streamflow and Runoff

**FLOOD HAZARD STUDY, LITTLE CALFPASTURE RIVER -- GRASSY RUN, AUGUSTA COUNTY, VIRGINIA.**  
Soil Conservation Service, Washington, DC.

Prepared in cooperation with the Virginia State Water Control Board, Headwaters Soil and Water Conservation District; and the Augusta County Board of Supervisors, June 1979. 51 p, 17 Fig, 3 Tab, 11 Ref, 1 Append.

Descriptors: \*Virginia, \*Flood plains, \*Flood damage, \*Historic floods, Flood forecasting, Hydrology, Flood plain zoning, Flood protection, Tropical cyclones, Thunderstorms, Runoff, Watershed management, Appalachian Mountain Region, Precipitation (Atmospheric), Precipitation excess, Little Calpasture River.

The flood plain for the Little Calpasture River and selected tributaries is defined and potential flood losses are identified. The drainage area for the river is 54.8 square miles and is part of the Maury River Subbasin of the James River in the Southern Appalachian Ridges and Valleys physiographic province. Normal annual precipitation is approximately 40 inches of which 19 inches is snowfall. About 80% of the drainage area is forested, about 12% cultivated, and the remaining 8% is comprised of towns and other miscellaneous uses. The flood plain itself has many residences and commercial structures built along the Chesapeake and Ohio Railroad and State Route 42. The flood plain is about 40% cropland; 30% idle brush and woods; 16% pasture; and 14% homes, commercial buildings, and other construction. Several tributaries and Grassy Run were included in the study. In the past tropical storms have caused major floods in the area with the largest reported in June 1949 although no gage records are available. It is estimated to be an 80-year flood which inundated 320 acres of crops and damaged about 30 homes. Due to the steepness of the area excess rainfall concentrates quickly, floods rapidly, and recedes rapidly. With present conditions an extreme flood would inundate about 360 acres with approximately 2 feet of water moving at about 3 feet/second. Sixty-nine buildings on the flood plain have the primary potential for damage. Recommendations are made for the development and implementation of a comprehensive flood plain management program. (Seigler-IPA) W80-03314

**DETERMINING PEAK-DISCHARGE FREQUENCIES IN AN URBANIZING WATERSHED--A CASE STUDY.**  
Corps of Engineers, Detroit, MI. Detroit District.  
For primary bibliographic entry see Field 2A. W80-03349

**FLOOD HYDROGRAPH AND PEAK FLOW FREQUENCY ANALYSIS.**  
Hydrologic Engineering Center, Davis, CA.  
For primary bibliographic entry see Field 2A. W80-03350

**TESTING OF SEVERAL RUNOFF MODELS ON AN URBAN WATERSHED.**  
Hydrologic Engineering Center, Davis, CA.  
For primary bibliographic entry see Field 2A. W80-03352

**SIZING FLOOD CONTROL RESERVOIR SYSTEMS BY SYSTEMS ANALYSIS.**  
Hydrologic Engineering Center, Davis, CA.  
For primary bibliographic entry see Field 6A. W80-03353

**THE RELATIONSHIP BETWEEN THE TIME BASES OF SIMULATION MODELS AND THEIR STRUCTURE.**  
Technion-Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.  
M. H. Diskin, and E. Simon.  
Water Resources Bulletin, Vol 15, No 6, p 1716-1732, December 1979. 6 Fig, 2 Tab, 9 Ref.

Descriptors: \*Mathematical models, \*Simulation analysis, \*Hydrology, \*Runoff, Model studies, Analytical techniques, Watersheds (Basins), Semiarid climates, Flow, Annual, Synthetic hydrology, Time base, Optimal parameters.

The time base of a simulation model can be defined as a combination of two time intervals. One is the interval used for input and internal computations. The second is the interval used for the output and calibration of the model. The time base of a model is related, on the one hand, to the type of applications for which the simulated data are used, and on the other hand, to the structure and complexity of the model. The latter may be represented by the number of parameters employed to specify the operation of the model. Using data typical to relatively small watersheds in a semiarid climate, the authors studied the interaction between the complexity of a series of models and the time bases used by them. This included the effects of the two factors, time base and complexity, on the values of the optimal parameters, prediction of mean annual flow, and general performance of the models. The main conclusion was that if the acceptable time base is longer, the model can be less complex needing fewer parameters. There is also an advantage in using a time base comprising a shorter input time interval and a longer output time interval. (Sims-ISWS) W80-03359

**PROBLEMS IN WEIGHTING OF HYETOGRAPHS.**  
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2B. W80-03365

**A HYDRAULIC TRANSIENT MODEL OF THE UPPER ST. LAWRENCE RIVER FOR WATER RESOURCES STUDIES.**  
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.  
A. J. Potok, and F. H. Quinn.  
Water Resources Bulletin, Vol 15, No 6, p 1538-1555, December 1979. 8 Fig, 4 Tab, 10 Ref.

Descriptors: \*St. Lawrence River, \*Lake Ontario, \*Great Lakes, \*Model studies, Mathematical models, Rivers, St. Lawrence Seaway, Water levels, Flow, River flow, Roughness (Hydraulic), Roughness coefficient, Ice cover, Hydrographs, Theoretical analysis, Hydraulics, Hydrology, Water resources, Water management (Applied), Manning's coefficient.

A one-dimensional hydraulic transient model has been designed for water resource studies of Lake Ontario and the Upper St. Lawrence River. The model simulates water surface profiles and flows in the St. Lawrence River between Lake Ontario and the Moses-Saunders Power Dam under both open water and ice-covered conditions. Errors in water surface elevations were found to be less than 0.2 feet during quasi-steady conditions on the river. Comparable errors occurred during the ice-covered conditions. A sensitivity analysis found the model to be most sensitive to the roughness coefficients and the flow through the power dam. (Sims-ISWS) W80-03366

**PRESENTATION OF LONGITUDINAL DISPERSION DATA.**  
Liverpool Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.  
P. C. Chatwin.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY1, Proceedings Paper 15150, p 71-83, January 1980. 3 Fig, 1 Tab, 25 Ref, 3 Append.

Descriptors: \*Dispersion, \*Flow, \*Model studies, Rivers, Turbulence, Data collections, Estuaries, Hydrology, Water pollution, Equations, Numerical analysis, Analytical techniques, Statistical methods, \*Longitudinal dispersion, Edgeworth series, Skewness, Kurtosis, Data analysis.

It was proposed that deviations from Gaussianity of observed profiles of the concentration of a solute in a cloud as it passes the measuring station in a river, estuary, or similar flow should be explicitly measured by recording the nondimensional

## Field 2—WATER CYCLE

### Group 2E—Streamflow and Runoff

skewness and kurtosis. Examples of applications of the proposal were examined. It was shown that observed profiles can be fitted well by Edgeworth series provided the skewness and kurtosis are not too large. Review of the way in which different causes of deviations from Gaussianity can be classified in terms of the evolution of the skewness and kurtosis with downstream position was given, and it was argued that this is the most important point of the proposal. (Lee-ISWS)  
W80-03379

**SCIENTIFIC ASPECTS OF THE 1975-76 DROUGHT IN ENGLAND AND WALES**, Proceedings of a Royal Society Discussion Meeting held on October 28, 1977. The Royal Society, London, England, 1978. 133 p.

Descriptors: \*Droughts, \*Watersheds(Basins), \*Conferences, \*Hydrology, Demonstration watersheds, Water balance, Agriculture, Groundwater, Aquifers, River systems, Surface waters, Planning, Groundwater resources, Meteorology, Evaporation, Rainfall, Soil moisture, Analytical techniques, Analysis, Crop response, Livestock, Foreign research, Reservoirs, Water quality, Water supply, Moisture deficit, Low flow, Low-flow frequency, Frequency, Water pollution, \*England, \*Wales.

The drought of 1975-76 was a rare event: the Royal Society discussion meeting about it was unique. The discussion, which is recorded in this volume, was made possible by the great expansion of hydrology in Britain during the past three decades, and the contributors, who had taken part in this expansion, came from government departments, research council institutes, and university departments. Here are the facts about the drought, partly within the historical sequence of such events, and partly in the context of what happened to Britain's near neighbors and of weather elsewhere in the Northern Hemisphere. The wide range of effects is shown in the impact the drought had on experimental catchments; on farming, including crops and stock, pests and diseases; on river behavior and the loads imposed on water resources—surface and underground—and the devices, used or planned, to deal with shortages; and on sewage disposal and other pollution problems. A forward look considers what summer 1976 has to teach in the planning of future development of Britain's water resources. (See also W79-06807 and W80-03445 thru W80-03450) (Humphreys-ISWS)  
W80-03444

**METEOROLOGICAL ASPECTS OF THE 1975-76 DROUGHT**, R. A. S. Ratcliffe.

In: Scientific Aspects of the 1975-76 Drought in England and Wales; Proceedings of a Royal Society Discussion Meeting held on October 28, 1977, p 3-20, 1978. 13 Fig, 17 Ref.

Descriptors: \*Droughts, \*Hydrology, \*Climatology, \*Model studies, Rainfall, Evaporation, Weather, Analysis, Analytical techniques, Meteorology, Moisture deficit, Weather data, Foreign research, Air circulation, Atmospheric pressure, \*England, \*Wales, Isotherms, Global aspects.

The broad scale meteorological features were examined, and it was shown that the drought was related to a variety of factors, including unusual coldness in the North Pacific Ocean and over Canada in the winter half-year, upper winds stronger than usual in the Central Pacific, and the quasi-biennial oscillation. Feedback mechanisms involving Atlantic sea temperatures and the drought itself helped to maintain the atmospheric mode. The additional evaporation from a reservoir in southern England due to extra sunshine, high summer temperature, etc., was estimated. An attempt was made to put the drought into historical perspective, with the conclusion that it appears to be a rare event rather than a symptom of climatic change. Lastly, by using a Meteorological Office general circulation numerical model, it was shown that a large area of dry ground may inhibit rainfall: the dryness of the ground over Western Europe in the 1976 summer may have had this effect. (See also W80-03444) (Humphreys-ISWS)

W80-03445

**SOME DETAILED WATER BALANCE STUDIES OF RESEARCH CATCHMENTS**, Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2A.  
W80-03446

**THE EFFECT OF THE DROUGHT ON BRITISH AGRICULTURE**, National Agricultural Advisory Service, London (England).  
E. S. Carter.

In: Scientific Aspects of the 1975-76 Drought in England and Wales; Proceedings of a Royal Society Discussion Meeting held on October 28, 1977, p 43-54, 1978. 8 Tab.

Descriptors: \*Droughts, \*Agriculture, \*Crop production, \*Crop response, Foreign research, Farm management, Productivity, Cereal crops, Horticultural crops, Grasslands, Livestock, Wheat, Barley, Oats, Viruses, Potatoes, Sugar beets, Poultry, Milk, \*England, \*Wales.

The drought was most severe in the south of the country, but had serious effects in all areas. The dry summer of 1975 followed by an unusually dry winter resulted in the majority of the country having a soil moisture deficit in May 1976. Crop production was affected both directly and indirectly through the buildup of certain pests and diseases favored by the weather. Grassland production was severely restricted, and some young leys killed out. Livestock remained remarkably fit, but milk yields fell and lambs and grazing cattle took longer to fatten. Supplementary feeding of hay, straw, and concentrates was necessary. Some cases of poisoning resulted from stock foraging for food where pasture was bare, and poor quality water supplies caused problems. There were losses of sheep, pigs, and calves due to high temperatures. Longer term effects of the drought include an enhanced persistence of soil-acting herbicides and residues. There was a remarkably quick recovery when the rains came. Pastures greened up rapidly and seeds sown under dry conditions germinated giving quite reasonable forage and other crops. The Meteorological Office claim that such a season was one in 500 years. (See also W80-03444) (Humphreys-ISWS)  
W80-03447

**THE EFFECTS OF DROUGHT ON THE RIVER SYSTEMS**, Birmingham Univ. (England). Dept. of Water Engineering.

For primary bibliographic entry see Field 2A.  
W80-03448

**POLLUTION PROBLEMS ARISING FROM THE 1975-76 DROUGHT**, Anglian Water Authority, Huntingdon (England). A. W. Davies.

In: Scientific Aspects of the 1975-76 Drought in England and Wales; Proceedings of a Royal Society Discussion Meeting held on October 28, 1977, p 97-107, 1978.

Descriptors: \*Droughts, \*Water pollution, \*Rivers, \*Groundwater, Surface waters, Sewerage, Sewage treatment, Water quality, Water supply, Bacteria, Algae, Low flow, Fisheries, Nitrates, \*England, \*Wales.

The paper considered the gradual transition from the 'normal' quality state of surface waters and groundwaters, and discussed the rapid change in the quality of these waters with the onset of heavy rain towards the end of August 1976. By the end of March 1977 the principal effects of the drought on river water quality had passed, and conditions were close to 'normal' for that time of year. The long term effects of using poor quality water to fill water supply reservoirs cannot be predicted accurately, but it is expected that these waters will present greater treatment difficulties in meeting water supply quality criteria in the future. The effect on groundwater quality may not become apparent for some time. This is particularly so for

water abstracted from chalk. The nitrate levels in limestone and gravel waters appear, at the time of writing (September 1977), to have reached the maximum and be decreasing, although some upturn is to be expected on the recharge of these aquifers during the forthcoming winter. It appears unlikely that the problems experienced during the postdrought period will recur unless a very dry summer is followed by an equally wet winter. The effect of the drought on the nitrate levels, particularly in groundwater, was to enhance the upward trend, which evidence available suggests commenced in the early 1950s. In retrospect, had not the drought been followed by very heavy rain, the problems of postdrought quality would have been more severe. The largest single factor which reduced the impact of postdrought pollution was dilution. (See also W80-03444) (Humphreys-ISWS)  
W80-03449

**PLANNING FOR DEVELOPMENT OF GROUNDWATER AND SURFACE WATER RESOURCES**, Central Water Planning Unit, Reading (England). O. Gibb, and H. J. Richards.

In: Scientific Aspects of the 1975-76 Drought in England and Wales; Proceedings of a Royal Society Discussion Meeting held on October 28, 1977, p 109-130, 1978. 6 Fig, 3 Tab, 11 Ref.

Descriptors: \*Planning, \*Droughts, \*Water resources development, \*Long-term planning, Surface waters, Groundwater resources, Water resources, Foreign research, Aquifers, Rainfall, Streamflow, Data collections, Hydrographs, Water quality, \*England, \*Wales, Water authorities.

The assessment and development of water resources were considered in relation to present demands and the developed and potential water resources of England and Wales. Normal seasonal changes in storage were compared with those of 1975-76 and conditions during this period compared with previous droughts. There is no basic shortage of water and the extent of restrictions which may have to be applied during drought events is largely determined by the price the consumer is prepared to pay for the safeguard of additional capacity and assured supply. Future trends in water resource planning were summarized as follows: (1) Increasing attention to studies of water use and control of waste with a view to more efficient water use and better forecasts of demand. Control of demand by more effective water-using appliances and the possibility of control by pricing. (2) More detailed hydrological assessments and the design of operating rules with particular attention to the benefits that may be derived from the combined use of different sources. (3) Increasing attention to environmental, amenity, and recreational aspects of water resource developments. (4) More detailed studies of appropriate reliability standards and their implications for the consumer. (5) Increasing attention to quality problems, in particular those associated with reuse of river water containing sewage and industrial effluents. Of these, combined use, reliability, and the quality problems of river-derived supplies were highlighted rather than identified by the 1975-76 drought. (See also W80-03444) (Humphreys-ISWS)  
W80-03450

**AGGRADATION IN STREAMS DUE TO OVERLOADING**, Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering.

For primary bibliographic entry see Field 2J.  
W80-03452

**FLOW PAST FENCE IN TURBULENT BOUNDARY LAYER**, Roorkee Univ. (India). Dept. of Civil Engineering.

For primary bibliographic entry see Field 8B.  
W80-03454

**A SYSTEMS MODEL OF STREAM FLOW AND WATER QUALITY IN THE BEDFORD-OUSE RIVER-1. STREAM FLOW MODELLING**,

## Streamflow and Runoff—Group 2E

Institute of Hydrology, Wallingford (England).  
P. Whitehead, P. Young, and G. Hornberger.  
Water Research, Vol 13, No 12, p 1155-1169, 1979.  
12 Fig, 1 Tab, 39 Ref.

Descriptors: \*Streamflow, \*Rainfall-runoff relationships, \*Rivers, \*Model studies, Mathematical models, Flow, River flow, Time series analysis, Analytical techniques, Rainfall, Precipitation (Atmospheric), Runoff, Hydrographs, Forecasting, Hydrology, \*England, \*Bedford-Ouse River (England).

This paper, the first of a two part description of the modeling activities associated with the Bedford-Ouse River Study, concentrated on streamflow characterization. The streamflow models are of a stochastic-dynamic type in which a simple lumped parameter differential equation model for mainstream flow is enhanced by stochastic time-series descriptions of rainfall-runoff behavior. The models have been developed using a new systematic approach to the modeling of badly defined dynamic systems which is centered around the exploitation of recursive methods of parameter estimation and time-series analysis. At the same time, the models have quite strong links with more conventional models used previously in hydrological systems analysis, and the implications of the modeling results can easily be interpreted in conventional hydrologic terms. An important aspect of the modeling exercises described in the paper was that they are objective orientated and, in the Bedford-Ouse Study, the models were developed specifically with operational control and management applications in mind. (Sims-ISWS)

W80-03456

**A HYDROLOGICAL ANALYSIS OF EAST AUSTRALIAN FLOODS USING NIMBUS-S ELECTRICALLY SCANNING RADIOMETER DATA,**  
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.  
For primary bibliographic entry see Field 7B.  
W80-03474

**A DISTANT READING RAINGAUGE,**  
Meteorological Office, Poona (India). Instruments Div.  
For primary bibliographic entry see Field 7B.  
W80-03476

**FLOODFLOW CHARACTERISTICS OF BUTTERNUT CREEK AND JAMESVILLE RESERVOIR, JAMESVILLE, ONONDAGA COUNTY, NEW YORK.**  
Geological Survey, Albany, NY. Water Resources Div.  
B. Dunn.  
Available from: OFSS U.S. Geological Survey Box 25425, Federal Center Denver, CO microfiche \$3.50 paper copy \$2.00. Geological Survey openfile report 79-1292, September 1979. 14 p, 3 Fig, 1 Tab, 13 Ref.

Descriptors: \*Flood, \*Flow characteristics, \*Model studies, \*Maximum probable flood, \*Design flood, Unit hydrographs, Discharge (Water), Dams, Peak discharge, Gaging stations, New York, \*Onondaga County (NY), \*Butternut Creek (NY), \*Jamesville Reservoir (NY), U.S. Army Corps of Engineers, HEC-1 program, Log-Pearson type III analysis.

A hydrologic study of Butternut Creek, near Jamesville, Onondaga County, N.Y., was done to develop inflow and outflow hydrographs of the 'probable maximum flood' and the 'standard project flood' of Jamesville Reservoir, as defined by the U.S. Army Corps of Engineers. The inflow and outflow discharges of the probable maximum flood were computed to be 23,600 and 23,100 cubic feet per second, respectively, and of the standard project flood, 9,400 and 8,800 cubic feet per second, respectively. A rating curve computed for the dam spillway indicates that water-surface elevations produced at the dam by runoff from both the standard project flood and the maximum probable flood would be above the top of the spillway abutments. The 10- and 100-year peak discharges

at the Butternut Creek gaging station were computed by the HEC-1 program of the Corps of Engineers to be 2,160 and 3,450 cubic feet, respectively, as compared to 1,680 and 2,810 cubic feet per second computed by a log-Pearson type III analysis of the station data. The HEC-1 values are within the 5- and 95-percent confidence limits of the log-Pearson type III values. (Kosco-USGS) W80-03488

**ASSESSMENT OF EFFECTS OF ALTERED STREAM FLOW CHARACTERISTICS ON FISH AND WILDLIFE. PART B: CALIFORNIA, CASE STUDIES.**  
Jones and Stokes, Inc., Sacramento, CA.  
For primary bibliographic entry see Field 6G.  
W80-03517

**TYPE 16 FLOOD INSURANCE STUDY: TSUNAMI PREDICTIONS FOR THE WEST COAST OF THE CONTINENTAL UNITED STATES,**  
Army Engineer Waterways Experiment Station, Vicksburg, MS.  
J. R. Houston, and A. W. Garcia.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A063 663, Price codes: A04 in paper copy, A01 in microfiche. Technical Report H-78-26, December 1978. 69 p, 30 Pl, 32 Ref, 1 Append.

Descriptors: \*Tsunamis, \*Mathematical models, Ocean waves, Coastal flooding, Earthquakes, Pacific Ocean, \*Flood insurance, \*West coast states, Wave runoff.

Calculations of runup due to tsunamis of distant origin were made for most of the west coast of the continental United States. Runup values were determined that were expected to be equalled or exceeded on the average of once per 100 or once per 500 years. Historical data of tsunami activity in distant generation regions were used in the investigation in conjunction with numerical models that generated tsunamis and propagated them across the deep-ocean and nearshore region. The combined effects of astronomical tides and tsunamis were also incorporated into the analysis. Numerical simulations of actual historical tsunamis and comparisons of calculations with tide gage recordings were presented. Calculations of tsunami runup based upon data of local historical tsunamis (at the few locations on the west coast where there was sufficient historical data to allow reasonable predictions) were compared with predictions based upon the methods presented in the investigation. (WES)

W80-03556

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XIV-APPENDIX M, FLOOD CONTROL.**  
Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 281, Price codes: A11 in paper copy, A01 in microfiche. Prepared for the Ohio River Basin Coordinating Committee, December 1967. 227 p, 38 Fig, 88 Tab, 25 Photographs.

Descriptors: \*Water resources development, \*Ohio River Basin, \*Multiple purpose projects, \*Flood control, \*Regional development, \*Flood damage, \*Flood protection, Flooding, Rivers, Control structures, Reservoirs, Non-structural alternatives, Land use, Planning, Flood plain management, Administration, Resources development, Natural resources, Water policy, Water resources, Peak discharge.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly within Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to determine the need for further flood control measures and to enhance the economic well being of the Basin. This Appendix discusses present basin flooding problems and future potential problems. Flooding in the Basin is a serious problem and, in spite of a major flood control program, the problems continue to grow.

The study area covers 163,000 square miles and has a population of 20 million persons. Current flood control measures include reservoirs, local protection projects, and non-structural measures. Potential solutions to the flood problem include additional development of control and prevention programs in all major sub-basins; more multipurpose reservoirs in sub-area basins; and better upstream land management and treatment which could reduce as much as 10% of flood damages. A potential future flood plan would include both additional upstream and downstream Federal control projects; non-structural measures such as land use regulation; and flood plain studies to identify the magnitude of the flood problem in the Basin. Flood problems and potential solutions are discussed for each of the 19 Ohio River sub-areas and the main stream. The methodology employed in the flood damage studies, the inventories used, and the procedures employed for determining and projecting upstream flood damages are presented. (Arnold-NC)

W80-03569

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME IV-APPENDIX C, HYDROLOGY.**  
Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 272, Price codes: A09 in paper copy, A01 in microfiche. Prepared for the Ohio River Basin Coordinating Committee, August 1966. 197 p, 10 Fig, 32 Tab, 40 Plates, 34 Ref.

Descriptors: \*Water resources development, \*Ohio River Basin, \*Hydrologic studies, \*Flood control, \*Hydrologic data, \*Runoff, \*Streamflow, \*Multiple purpose projects, \*Standard Project Flood, \*Floods, \*Hydrology, Ice jams, Flood protection, Historic floods, Reservoirs, Flood stages, Flood forecasting, Droughts, Low flow, Sedimentation, Precipitation, Climatology, Meteorology, Watershed (Basins), Control structures.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly for that part within Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin. This Appendix contains climatologic and hydrologic data for the analysis of water and related land resource problems in the Basin and formulation of a comprehensive framework plan for their solution. The data presented provide a basis for discussion of water problems and solutions contained in other appendices. Data are presented on precipitation and streamflow, magnitudes and frequency of floods and frequency of low flows. Availability of surface water is also estimated. Topography in the Basin is varied from flat and rolling plains to mountains. All major rivers in the Basin have dam and lock systems. Precipitation is distributed throughout the year, although severe droughts have occurred. The flood season is from December through April, with major recent floods occurring in 1963 and 1964. The worst flood occurred in 1937, equalling the Standard Project Flood (SPF) in duration and discharge levels. By 1964 38 reservoirs for flood control had been completed, with 9 others under construction and engineering studies being made for an additional 6. Profiles are presented for the SPF. Flood data are presented for the Basin. (Arnold-NC)

W80-03578

**AN URBAN RUNOFF MODEL FOR TULSA, OKLAHOMA,**  
Texas Univ. at Austin. Center for Research in Water Resources.  
For primary bibliographic entry see Field 6A.  
W80-03582

**THE DEVELOPMENT AND SERVICING OF SPATIAL DATA MANAGEMENT TECHNIQUES IN THE CORPS OF ENGINEERS,**  
Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch.

## Field 2—WATER CYCLE

### Group 2E—Streamflow and Runoff

For primary bibliographic entry see Field 6A.  
W80-03588

**FLOOD DAMAGE ASSESSMENTS USING SPATIAL DATA MANAGEMENT TECHNIQUES**, Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch.  
For primary bibliographic entry see Field 6A.  
W80-03589

**SPATIAL DATA ANALYSIS OF NONSTRUCTURAL MEASURES**, Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch.  
For primary bibliographic entry see Field 6A.  
W80-03590

**VERY LARGE FLOODS IN THE BRAHMAPUTRA RIVER IN AUGUST 1962, PART I: SYNOPSIS ASPECTS**, Observatory, New Delhi (India).  
For primary bibliographic entry see Field 2B.  
W80-03598

### 2F. Groundwater

**IDENTIFICATION OF AQUIFER PARAMETERS USING NUMERICAL TECHNIQUES**, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
S. Neuman, and S. Yakowitz.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143696, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center, University of Arizona Project Completion Report (1979), 16 p, 15 Ref, OWRT B-051-ARIZ (3), 14-34-0001-7135.

Descriptors: Groundwater, \*Mathematical models, \*Aquifer characteristics, Hydrogeology, \*Transmissivity, Regression analysis, Numerical analysis, \*Water level fluctuations, Arizona, Parameter identification, Numerical methods, Cortaro basin(Ariz).

A new statistically based approach to the problem of estimating spatially varying aquifer transmissivities on the basis of steady state water level and flux data has been developed. The method involves solving either one, or a series of, generalized nonlinear regression problems. When there is a need to solve a series of such problems, the method requires selecting one particular solution from this series by means of a comparative analysis of residuals. A linearized error analysis of the solution is included. This analysis allows one to estimate the covariance of the transmissivity estimates as well as the square error of the estimates of hydraulic head. In addition to the explicitly statistical orientation of the method, it has an additional feature of permitting the user to incorporate a priori information about the transmissivities. This information may be based on actual field data such as pumping tests, or on statistical data accumulated from similar aquifers elsewhere in the world. The new method has been applied to actual field data from the Cortaro Basin in Southern Arizona. The estimated transmissivities were shown to compare favorably with those obtained earlier for the same basin by an ad hoc trial-and-error procedure. Both sets of transmissivity values have been used successfully in conjunction with a mixed explicit-implicit finite element model to reproduce 25 years of water level variations in the Cortaro Basin in response to pumping during the period 1940-1965. The finite element model has revealed some important features of the local hydrogeological regime which have not been recognized previously.  
W80-03305

**GAS CONCENTRATIONS AND AGES OF GROUNDWATERS IN BEAUFORT GROUP SEDIMENTS, SOUTH AFRICA**, Council for Scientific and Industrial Research, Pretoria (South Africa). Natural Isotopes Div.  
T. H. E. Heaton, and J. C. Vogel.

Water S. A., Vol 5, No 4, p 160-170, October 1979.  
6 Fig, 3 Tab, 38 Ref.

Descriptors: \*South Africa, \*Groundwater, \*Hydrogeology, \*Gases, Hydrogen, Helium, Methane, Nitrogen, Oxygen, Water properties, Spectrometers, Chemical analysis, Water sampling, Boreholes, Hydrology, Fractures(Geologic), Fracture permeability.

As part of a geophysical and hydrological study groundwater samples from 25 sites along the 120 km middle-upper stretch of the Orange River in Cape Province and Orange Free State were analyzed for dissolved He, Rn, Ra, CH<sub>4</sub>, N<sub>2</sub>, O<sub>2</sub>, and Ar concentrations and for their 14C and 3H ages. Rocks in the area are part of the Beaufort group. Burial metamorphism of Karoo sediments in the area has produced methane-rich gas and oil traces. Previous hydrological investigations indicate that groundwater age in the area increases with depth, however, the movement and mixing of water along vertical fractures and along contact zones between dikes and sediments is likely. Gas analyses were performed in an Atlas M86 mass spectrometer calibrated using atmospheric air and gas mixtures of known composition. Large variations in the concentrations of He and CH<sub>4</sub> were found. A correlation between He-CH<sub>4</sub> concentrations and the 14C-3H ages of samples was also found. Results indicate that low He and CH<sub>4</sub> concentrations characterize young near-surface recently recharged groundwater while high CH<sub>4</sub> concentrations characterize deeper older groundwater. The He concentrations in the samples were too high to be accounted for solely by groundwater. The Rn concentrations indicated that the near-surface uranium environment of the different waters is fairly uniform. High N<sub>2</sub> and Ar concentrations indicate that excess air may be trapped in the waters during initial infiltration. Old groundwater had low O<sub>2</sub> concentrations. (Seigler-IPA)  
W80-03322

**BETTER UTILIZATION OF GROUND WATER IN THE PIEDMONT AND MOUNTAIN REGION OF THE SOUTHEAST**, Geological Survey, Raleigh, NC. Water Resources Div.  
For primary bibliographic entry see Field 6D.  
W80-03327

**OVERFLOW TESTS ANALYSED BY THEORETICAL AND NUMERICAL METHODS**, Birmingham Univ. (England). Dept. of Civil Engineering.  
K. R. Rushton, and K. S. Rathod.  
Ground Water, Vol 18, No 1, p 61-69, January-February 1980. 8 Fig, 6 Ref.

Descriptors: \*Water wells, \*Artesian wells, \*On-site tests, \*Theoretical analysis, Overflow, Drawdown, Water yield, Transmissivity, Storage, Storage coefficient, Mathematical models, Numerical analysis, Flow, Discharge(Water), Wells, Water resources, Water supply, Groundwater, Overflow tests.

The assumptions inherent in the theoretical analysis of constant drawdown overflow test are difficult to achieve in practice. This paper showed that, even if there is a restriction in the flow which causes some delay in the achievement of the constant drawdown condition, the theoretical discharge curve is followed once the constant drawdown condition is reached. Recovery tests following overflow were also examined, and it was shown that the discharge used in the calculation should be the discharge at the instant that the test is stopped. Further, it was demonstrated that if well and formation losses occur, the aquifer response is distinctly different from that of the theoretical analysis. A brief description was given of an alternative method of analysis using a numerical model. A preliminary study of a field test yielded promising results. (Sims-ISWS)  
W80-03356

**THEIS PARAMETER EVALUATION FROM PUMPING TESTS BY SENSITIVITY ANALYSIS**,

Geological Survey, Lawrence, KS.  
C. D. McElwee.

Ground Water, Vol 18, No 1, p 56-60, January-February 1980. 2 Tab, 14 Ref.

Descriptors: \*Groundwater, \*Pumping, \*Drawdown, \*Model studies, Mathematical models, Transmissivity, Storage, Equations, Mathematics, Aquifers, Hydraulic conductivity, Hydrology, Theis equation.

Through the years the Theis equation has played an important role in groundwater hydrology. Comparison of experimental pumping-test data with this theoretical curve by graphic means has been a standard method of determining aquifer transmissivity and storage. The purpose of this paper was to present a technique and an algorithm to fit automatically experimental pumping-test data to the Theis equation by obtaining the 'best' transmissivity and storage in the least squares sense through the use of sensitivity analysis. The automated fit for pumping-test data developed in this work should be a useful tool for the groundwater hydrologist. Use of the technique is simple, quick, and inexpensive, and has the advantage of always being objective. As a measure of the error in fitting, the rms deviation in drawdown was calculated for the 'best' transmissivity and storage. (Sims-ISWS)  
W80-03357

**RESISTIVITY INVESTIGATIONS FOR GROUND WATER IN METAMORPHIC AREAS NEAR DHANBAD, INDIA**, Indian School of Mines, Dhanbad. Dept. of Applied Geophysics.  
R. K. Verma, M. K. Rao, and C. V. Rao.  
Ground Water, Vol 18, No 1, p 46-55, January-February 1980. 9 Fig, 7 Ref.

Descriptors: \*Groundwater, \*Resistivity, \*Surveys, On-site investigations, Electrical resistance, Aquifers, Water yield, Water resources, Geology, Rocks, Data processing, Regression analysis, Analytical techniques, Hydrogeology, \*India.

Despite sufficient rainfall, large parts of eastern India suffer from water scarcity. Groundwater occurs in weathered or semi-weathered/fractured layers in hardrock areas whose thickness varies, in general, from 5 to 20 m. Groundwater studies were carried out in several areas in and around Dhanbad (Lat. 23 deg 48 min N, Long. 86 deg 24 min E) in Bihar State of India. The area covers Precambrian hornblende and feldspathic gneisses, schists, granulites, quartzites, metabasites, and pegmatites. The area forms a part of ENE-WSW trending Satpura orogenic belt. The quartz reefs formed as fault fillings act as barriers to the flow of groundwater. Geophysical investigations, using electrical methods, with Schlumberger configuration using AB up to 300 m, were carried out at most of the locations. Conventional resistivity meters were used for this purpose. The data from 78 Schlumberger soundings were analyzed. Both A and H type curves were obtained. Spectra of resistivity values were prepared to study the overall variation of resistivity values in the area. It was observed that the curves with arithmetic mean values are quite representative. The values obtained from spectral and regression analyses are nearly the same. The results of geoelectric soundings were compared with the geological section wherever available. It was inferred that the thickness of the weathered layer as deduced from Schlumberger soundings includes partly the unweathered/fractured layer as well. An attempt was made to find an empirical relationship between the daily yield of water in gallons/day and the longitudinal conductance ( $\sigma = h/\rho h$ ) of the weathered layer. Two empirical relationships were obtained, one for the winter months, December-January, and the other for the summer months, June-July. A suitable explanation for the two curves was given. (Sims-ISWS)  
W80-03358

**MODEL FOR ESTIMATING ELECTRIC MACROANISOTROPY COEFFICIENT OF AQUIFERS WITH HORIZONTAL AND VERTICAL FRACTURES**,

Geological Survey, Denver, CO.

D. L. Campbell.  
Geophysics, Vol 42, No 2, p 114-117, February, 1977. 4 Fig, 5 Ref.

Descriptors: \*Anisotropy, \*Aquifers, \*Fractures, Resistivity, Mathematical models, Aquifer characteristics.

A model for estimating the macroanisotropy of fractured beds is presented. This model takes into account both horizontal and vertical fractures. The aquifer is assumed to extend infinitely in the two horizontal directions and current flow is assumed to be perfectly vertical and horizontal. The macroanisotropy coefficient is plotted as a function of horizontal and vertical crack fraction and horizontal crack fraction and vertical vug fraction. A very small fraction of vertical cracks is sufficient to lower the anisotropy coefficient to unity. When there are no horizontal cracks and vertical cracks take up 8 percent of the width of the aquifer, the anisotropy coefficient equals .742. Thus, a vertical electric sounding will assign the aquifer only about three-fourths its true thickness. In the case of a vuggy aquifer, the absence of horizontal cracks can result in a coefficient as low as .226 or an interpreted thickness less than one-fourth its true thickness. (Purdin-NWWA)  
W80-03434

**SCIENTIFIC ASPECTS OF THE 1975-76 DROUGHT IN ENGLAND AND WALES.**  
For primary bibliographic entry see Field 2E.  
W80-03444

**ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN CARSON COUNTY, TEXAS, PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS.**  
Texas Dept. of Water Resources, Austin.  
For primary bibliographic entry see Field 7C.  
W80-03451

**CURRENT SUBSURFACE INTRUSION OF MEDITERRANEAN SEAWATER—A POSSIBLE SOURCE OF GROUNDWATER SALINITY IN THE RIFT VALLEY SYSTEM, ISRAEL.**  
Geological Survey of Israel, Jerusalem.  
For primary bibliographic entry see Field 2A.  
W80-03472

**THE PALEOHYDROLOGY OF SOUTHERN ISRAEL AND ITS INFLUENCE ON THE FLUSHING OF THE KURNUB AND 'ARAD GROUPS (LOWER CRETACEOUS AND JURASSIC).**  
Ben Gurion Univ. of the Negev, Beersheba (Israel). Inst. of Research.  
For primary bibliographic entry see Field 2A.  
W80-03473

**MAP SHOWING GROUND-WATER CONDITIONS IN THE BODAWAY MESA AREA, COCONINO COUNTY, ARIZONA—1977.**  
Geological Survey, Tucson, AZ. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W80-03481

**THE COFFEE SAND AND RIPLEY AQUIFERS IN MISSISSIPPI.**  
Geological Survey, Jackson, MS. Water Resources Div.  
E. H. Boswell.  
Geological Survey Water-Resources Investigations 78-114 (open-file report), 1978. 1 Sheet, 6 Fig, 2 Tab, 19 Ref.

Descriptors: \*Mississippi, \*Groundwater resources, \*Aquifer characteristics, \*Water quality, \*Water utilization, Maps, Water wells, Water levels, Well data, Water yield, Groundwater availability, Water supply, Selma Group, \*Coffee Sand, Ripley formation, Cretaceous aquifers.

The Coffee Sand and Ripley aquifers, of Cretaceous age, are in the Selma Group in northern Mississippi. The aquifers contain freshwater in an area of about 4,400 square miles in northern Mississippi. Water produced from the aquifers by public water systems and numerous industries in 1975 averaged about 4 Mgal/d. Regional water-level declines have been very small and the aquifers have a moderate potential for future development. The aquifers are used in some areas where there are no other significant sources of ground water. The most common problems in developing water supplies are low yields to wells and hard water. (Kosco-USGS)  
W80-03484

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME VI—APPENDIX E, GROUNDWATER.**  
Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 274.  
Price codes: A12 in paper copy, A01 in microfiche.  
Prepared by the U.S. Geological Survey, Water Resources Division, for the Ohio River Basin Coordinating Committee, 1965. 258 p, 12 Tab, 23 Plates, 19 Ref, 12 Append.

Descriptors: \*Water resources development, \*Groundwater resources, \*Aquifers, \*Groundwater availability, \*Water sources, \*Water supply, \*Geologic control, \*Ohio River Basin, \*Water management, Water quality, Groundwater recharge, Groundwater-surface relationships, Alluvial aquifers, Retention, Hydrology, Geology, Sediment.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin, particularly for that portion within Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin. This Appendix investigates the uses and quality of groundwater resources in the Basin. The specific objectives were to make a general appraisal of the groundwater resources; to present information in readily useable format for long-range planning and as a management guide; and to identify hydrologic factors that should be taken into account in formulating and implementing water resource development plans. Data are presented for the Basin as a whole and in detailed reports for 12 sub-regions. Conclusions indicate that, although groundwater resources provide great potential for future development, this will be limited by water quality problems relating to the natural quality of groundwater as well as contamination to both ground and surface waters. The volume of permeable sediments is enormous; the Ohio River provides a large source of water to recharge the underlying valley fill. Development will be limited by technical problems of recharging these sediments, by quality of the Ohio River water, and by economic considerations. Groundwater sources will provide water supplies for future needs over large areas throughout the Basin, although in small areas groundwater conditions are so unfavorable that even small supplies are unobtainable. More studies are needed on the effects on quality caused by interflow of water between surface and sub-surface sources. (Arnold-NC)  
W80-03576

**MEASUREMENTS OF VERTICAL FLOW IN GROUND WATER BORINGS AND HYDROLOGICAL PARAMETERS FOR ASSESSING GROUND WATER POLLUTION.**  
Bhabha Atomic Research Centre, Bombay (India).  
For primary bibliographic entry see Field 5B.  
W80-03599

## 2G. Water In Soils

**AN ELECTRICAL CONDUCTANCE METHOD FOR DETERMINING CONDENSATION AND EVAPORATION PROCESSES IN ARID SOILS WITH HIGH SPATIAL RESOLUTION.**

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Hanover (Germany, F. R.). Inst. fuer Strahlenbotanik.  
For primary bibliographic entry see Field 2D.  
W80-03470

**CHANGES IN DECOMPOSITION RATE, MICROBIAL POPULATION AND CARBOHYDRATE CONTENT OF AN ACID PEAT BOG AFTER LIMING AND RECLAMATION.**  
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.  
K. C. Ivarson.  
Canadian Journal of Soil Science, Vol 57, No 2, p 129-137, May, 1977. 1 Fig, 3 Tab, 42 Ref.

Descriptors: \*Peat, \*Nutrients, \*Decomposition, \*Soil microorganisms, Lime, Wetlands, Bogs, Soil, Fungi, Bacteria, Temperature, Hydrogen ion concentration, Ecological effects, Ecology, Canada, Nitrogen, Phosphorus, Potassium.

After eight months of decomposition under laboratory conditions, the unlimed surface sample of an acid peat bog near Alfred, Ontario, contained about five times as many microbes as the unlimed subsurface material. As measured by CO<sub>2</sub>-C released and numbers of bacteria and actinomycetes, lime had greater effects on the microbial activity of the surface material. Nitrifying bacteria were present and needed lime to become active. Twelve genera of fungi were found and fungal numbers decreased with lime. Temperature had little effect whereas pH had a marked effect on fungal genera distribution. Before incubation, the unlimed lower sample was higher in carbon, nitrogen and methoxyl but lower in hexose, pentose and uronic acid than the unlimed upper sample. Hexose and pentose tended to decrease more noticeably in the upper material during decomposition while the other compounds showed no appreciable changes in either layer. Dry matter lost in the surface sample ranged from 8 to 13% and from 2.0 to 3.5% in the lower material. Despite sufficient nitrogen, phosphorus, and potassium and a substantial sugar content, sphagnum litter decomposes at a slower rate than some tree leaf litters. This may be due to the presence of microbial inhibiting substances. (Howard-Mass)  
W80-03534

**AN ANALYSIS OF INFILTRATION IN INITIAL GRADIENT SOILS.**  
Punjab Agricultural Univ., Ludhiana (India).  
J. P. Soni, and P. Basak.  
Mausam, Vol 30, No 1, p 51-54, January 1979. 3 Fig, 1 Tab, 19 Ref.

Descriptors: \*Infiltration, \*Soil water, \*Hydraulic gradient, \*Model studies, Mathematical models, Wetting, Soils, Soil water movement, Irrigation, Drainage, Hydraulic conductivity, Moisture content, Hydrology.

Flow through loamy and clay soils starts only when the hydraulic gradients exceed a certain value called initial gradient, thus giving rise to non-Darcian flow. An analytical solution of the problem of infiltration into homogeneous soil with initial gradient was presented, which can be quite useful in the area of irrigation and drainage. The effect of initial gradient on the advance of wetting front, the infiltration rate, and accumulated depth of infiltration was clearly brought out, and it was found that the nonrecognition of initial gradient in soils leads to the overestimation of these values. (Sims-ISWS)  
W80-03600

## 2H. Lakes

**EFFECTS OF DESTRATIFICATION ON SEDIMENT CHEMISTRY AND BENTHIC MACROINVERTEBRATES IN HAM'S LAKE.**  
Oklahoma State Univ., Stillwater. School of Biological Sciences.  
J. Wilhm, D. Barker, E. Cover, E. Clay, and R. Fehrer.  
Available from the National Technical Information

## Field 2—WATER CYCLE

### Group 2H—Lakes

Service, Springfield, VA 22161 as PB80-143639. Price codes: A03 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute, Oklahoma State University, Final Technical Completion Report, December 1979. 40 p, 7 Tab, 39 Ref, OWRT A-079-OKLA (1), 14-34-0001-9038.

Descriptors: \*Destratification, \*Benthic fauna, \*Bloodworms, \*Bottom sediments, Oklahoma, Water sampling, Water chemistry, Water temperature, Dissolved oxygen, Stratification, Particle size, Ponds, Mixing, Hypolimnion, Turnovers.

Ham's Lake built in 1965 near Stillwater, Oklahoma, was artificially destratified by mechanical pumping and sampling was conducted to determine changes in physicochemical conditions, sediments and heavy metals, and physiological conditions in *Chironomus punctipennis* (phanon midge) and *Chironomus riparius* (bloodworm). Samples were taken from two stations, one in the central pool that was mixed by pumping oxygen-rich surface water downward, and one that was unmixed due to a submerged dam from a former farm pond. Hypolimnetic water parameters tested include: temperature, dissolved oxygen, conductivity, pH, alkalinity, iron, manganese, copper, zinc, sodium, potassium, and chloride. Sediment parameters tested include particle size, organic carbon, phosphorus, clay mineral composition, pH, iron, manganese, zinc, caloric content, and oxygen uptake. The benthic macroinvertebrates *Chaoborus* and *Chironomus* were tested for concentrations of iron, manganese, and zinc; caloric content; hemolymph ion concentration; osmotic pressure; and oxygen uptake. Results show that dissolved oxygen was 3 to 5 mg/l higher in the mixed area and temperature was 6 to 8°C higher in the mixed area. Water in the mixed area also had a lower concentration of total manganese. The stratified area showed a greater concentration of organic matter with greater oxygen uptake and hemolymph Na concentration of *Chaoborus*. Extensive data and results are provided. (Seigler-IPA)

W80-03308

**OPERATIONAL SIMULATION OF A RESERVOIR SYSTEM WITH PUMPED STORAGE,**  
Corps of Engineers, Savannah, GA.  
For primary bibliographic entry see Field 6A.  
W80-03351

**A HYDRAULIC TRANSIENT MODEL OF THE UPPER ST. LAWRENCE RIVER FOR WATER RESOURCES STUDIES,**  
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.  
For primary bibliographic entry see Field 2E.  
W80-03366

**THE PROBLEM OF PHOSPHORUS IN THE EUTROPHIC LAKE MARYUT,**  
Alexandria Inst. of Oceanography and Fisheries (Egypt).  
For primary bibliographic entry see Field 5B.  
W80-03371

**THERMAL PREDICTIONS USING INTEGRAL ENERGY MODEL,**  
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.  
D. E. Ford, and H. G. Stefan.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY1, Proceedings Paper 15119, p 39-55, January 1980. 15 Fig, 2 Tab, 19 Ref, 2 Append.

Descriptors: \*Lakes, \*Water temperature, \*Model studies, Mathematical models, Stratification, Profiles, Temperature, Energy, Heating, Winds, Circulation, Mixing, Water quality, Environment, Limnology.

A one-dimensional integral energy model (mixed-layer model) was used to simulate the seasonal temperature cycle of three, morphometrically different, temperate lakes. In the model, turbulent kinetic energy supplied by wind shear was used to

entrain denser water into the upper mixed layer by working against gravity. The model was calibrated with data from one lake for 1 yr and verified against data from two other lakes and also against data from other years. Predictions of the onset of stratification, surface and hypolimnetic temperatures, mixed layer depths, and periods of turnover were all in agreement with data. (Sims-ISWS)

W80-03380

**SEASONAL CYCLES OF ZOOPLANKTON BIOMASS IN SOUTHEASTERN LAKE MICHIGAN,**  
Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.  
B. E. Hawkins, and M. S. Evans.  
Journal of Great Lakes Research, Vol 5, No 3-4, p 256-263, 1979. 3 Fig, 3 Tab, 24 Ref.

Descriptors: \*Lake Michigan, \*Zooplankton, \*Copepods, \*Biomass, Standing crops, Productivity, Crustaceans, Aquatic animals, Lake stages, Water temperature, Seasonal, Monthly, Fluctuation, Period of growth, Oligotrophy, Mesotrophy.

Spatial and seasonal variations in the crustacean zooplankton biomass in a 250 sq m area of Lake Michigan were studied from 1975 through 1977 as part of an environmental monitoring project for the Donald C. Cook Nuclear Power Plant. A combination of dry weight estimates of individuals of zooplankton species and numerical density (number per cu m) estimates were used to calculate monthly biomass estimates. Animals from an in-shore station 9 m in depth and from an offshore station 40 m in depth were weighed and considered to be representative of the range of physical conditions found in the test area. Results show a greater biomass for deeper, offshore stations due to the dominance of large copepod zooplankton that were rare at the inshore stations. The mean annual standing stock was calculated at 60 mg/cu m which is lower than other Great Lakes and is considered to be characteristic of oligotrophic or mesotrophic lakes. Total zooplankton biomass fluctuated seasonally due to changes (up to 70%) in the mean weight of individual taxa as well as changes in weight per individual. Inverse correlations were found between temperature in the month prior to a collection and the body length and weight of *C. bicuspidatus thomasi*, *D. ashlandi*, and *D. minutus*. For several species the seasonal weight cycles were related to the growth of new generations and the temperatures occurring during the development period. (Seigler-IPA)

W80-03390

**ALGAL AND INVERTEBRATE COMMUNITIES IN THREE SUBARCTIC LAKES RECEIVING MINE WASTES,**  
For primary bibliographic entry see Field 5C.  
W80-03457

**THE EFFECT OF WASTEWATER PHOSPHORUS REMOVAL ON SHAGAWA LAKE, MINNESOTA: PHOSPHORUS SUPPLIES, LAKE PHOSPHORUS AND CHLOROPHYLL A,**  
Corvallis Environmental Research Lab., OR.  
For primary bibliographic entry see Field 5C.  
W80-03459

**SPECIES VERSATILITY IN SHORE HABITATS,**  
Harvard Univ., Petersham, MA. Harvard Forest.  
For primary bibliographic entry see Field 2I.  
W80-03521

**A PALAEOECOLOGICAL STUDY OF HOLOCENE PEAT BOG SECTIONS IN GERMANY AND THE NETHERLANDS, BASED ON THE ANALYSIS OF POLLEN, SPORES AND MACRO- AND MICROSCOPIC REMAINS OF FUNGI, ALGAE, CORMOPHYTES AND ANIMALS,**  
Amsterdam Univ. (Netherlands). Hugo de Vries Lab.  
B. Van Geel.  
Review of Palaeobotany and Palynology, Vol 25,

p 1-120, 1978. 27 Fig, 6 Tab, 130 Ref.

Descriptors: \*Bogs, \*Palynology, \*History, Wetlands, Peat, Pollen, Palaeoclimatology, Marsh plants, Succession, \*Germany, \*Netherlands.

A peat section of the Engbertsdijkveen (The Netherlands) was analyzed for micro-macrofossils in order to obtain maximum information regarding local vegetation and animal succession and regional changes in the prevailing vegetation types. Analysis of the remains and the correlation of the events inside and outside the peat bog site lead to the following conclusions: The Atlantic-Subboreal transition, known for its elm decline, could be correlated with a local change in bog vegetation. Following the alteration of wet Scheuchzeria palustris vegetation with hummock vegetation in the Atlantic period, the appearance of a *Molinia coerulea* peat coincides with the elm decline. During the climatic deterioration of the Subboreal-Subatlantic transition, the incidence of *Corylus avellana* decreased. Depressions in the *Corylus* pollen curve corresponds with particularly wet local vegetation, *Corylus* pollen maxima correspond with relatively dry bog vegetation. These cyclic fluctuations correspond to approximately 150-200 historical years each. The increasing oceanicity ultimately resulted in the formation of peat by *Sphagnum* species of the section *Cymbifolia*. All available data were expressed in curves, in order to indicate changes in local and perhaps regional moisture conditions. (Steiner-Mass)

W80-03525

**MIRES OF THE MANAPOURI-TE ANAU LOWLANDS,**  
Canterbury Univ., Christchurch (New Zealand). Dept. of Botany.  
For primary bibliographic entry see Field 2I.  
W80-03528

**STUDIES ON THE MICRO-FAUNA OF BLANKET BOG WITH PARTICULAR REFERENCE TO ENCHYTRAETIDAE. I. FIELD AND LABORATORY TESTS OF MICRO-ORGANISMS AS FOOD,**  
Nature Conservancy, Alston (England). Moor House Field Station.  
For primary bibliographic entry see Field 2I.  
W80-03531

**THE CONTRIBUTION OF MACROPHYTES TO THE METALIMNETIC OXYGEN MAXIMUM IN A MONTANE, OLIGOTROPHIC LAKE,**  
Virginia Univ., Charlottesville. Dept. of Biology.  
For primary bibliographic entry see Field 2I.  
W80-03533

### 2I. Water In Plants

**MANAGEMENT OF PINUS PINASTER PLANTATIONS ON THE SWAN COASTAL PLAIN FOR TIMBER AND WATER YIELD,**  
Western Australia Dept. of Forests, Perth.  
T. B. Butcher.  
Australian Water Resources Council Technical Paper No 42, 1979. 68 p, 26 Fig, 16 Tab, 22 Ref, 3 Append.

Descriptors: \*Australia, \*Forest management, \*Water management (Applied), \*Groundwater resources, Groundwater recharge, Seepage, Evapotranspiration, Climatology, Water loss, Soil moisture, Infiltration rates, Recharge, Pine trees, Lumber.

The management of underground water resources and forest resources of State Forest No 65 on the Swan Coastal Plain in Australia was studied to develop a program for economic sawlog production and acceptable water yields to underlying aquifers. This area, north of Perth, contains the largest contiguous area of exotic pine plantations in Western Australia. Under this forested area is a large water resource which can potentially supply 20% of Perth's water needs. By controlling the

## Water in Plants—Group 21

number of trees uptake of water by the pines can be balanced with water recharge of the soil. The area has a Mediterranean type climate with cold moist winters and hot dry summers. Because 86% of the annual rainfall occurs in winter when evapotranspiration rates are low, about 75% of the rainfall is available for soil storage and groundwater recharge. The forest currently produces sawlogs at the rate of 900,000 cu m per year. Future sawlog requirements are estimated at 1,400,000 cu m by the year 2010. Water infiltration and evapotranspiration losses can be altered by changing forest density. A heavy pine canopy can intercept 30% of rainfall while thinning can increase effective rainfall by 20%. Plans for the management of the three sectors of the forest are given. The objectives for the southern sector are to provide water, timber, and recreation; for the central sector, water timber, ecotype preservation, and recreation; and for the northern sector, timber and ecotype preservation. (Seigler-IPA)  
W80-03385

**PHREATOPHYTE EVAPOTRANSPIRATION AND ITS POTENTIAL REDUCTION WITHOUT ERADICATION,**  
California Univ., Davis. Dept. of Land, Air and Water Resources.  
For primary bibliographic entry see Field 2D.  
W80-03442

**DEALING WITH SITE DISTURBANCES FROM HARVESTING AND SITE PREPARATION IN THE LOWER COASTAL PLAIN,**  
Southern Forest Experiment Station, Pineville, IA. Forest Insect Research.  
For primary bibliographic entry see Field 4C.  
W80-03503

**SALT MARSHES AND SALT DESERTS OF THE WORLD,**  
Auckland Univ. (New Zealand). Dept. of Botany.  
For primary bibliographic entry see Field 2L.  
W80-03504

**ENVIRONMENT, VEGETATION AND PHYTOGEOGRAPHY OF THE HIGH-ALTITUDE BOGS OF LESOTHO,**  
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Science.  
E. M. van Zinderen Bakker, and M. J. A. Werger.  
Vegetatio, Vol 29, No 1, p 37-49, July 7, 1974. 4 Fig, 4 Tab, 38 Ref.

Descriptors: \*Bogs, \*Rooted aquatic plants, \*Ecological distribution, \*Alpine, \*Africa, Wetlands, Marshes, Swamps, Freshwater marshes, Ecology.

High summer rainfall and diurnal climate are characteristic of the rivershed region of the Lesotho mountains in the eastern escarpment of Southern Africa. The daily frost-thaw regime at ground level causes up-freezing, small polygons, terraces and the formation of thufur in the bogs. The bogs originated in post-glacial times around springs or from small alpine lakes. The bogs are of significance for the regular flow of clear water and for grazing. They are in the process of being eroded through animal trampling and measures for protection are being proposed. Plant communities occurring at high altitudes on thufur and in depressions in the stream head bogs of Lesotho are analyzed and described. The bog vegetation is compared to surrounding tussock grasses and dwarf shrub vegetation. Chronological analysis of the bog flora showed a pattern of three phytogeographical groups of species: a South African group, a southern and eastern African group, and a northern temperate group. (Howard-Mass)  
W80-03507

**SEASONALITY, DENSITY AND DIVERSITY OF BIRDS OF A PAPYRUS SWAMP IN WESTERN KENYA,**  
Shimo-la-Tewa School, Mombasa (Kenya).  
P. L. Britton.  
Ibis, Vol 120, No 4, p 450-466, October, 1978. 6 Fig, 5 Tab, 65 Ref, 1 Append.

Descriptors: \*Birds, \*Density, \*Rooted aquatic plants, \*Swamps, Wetlands, Ecological distribution, Ecology, Africa.

The avifauna of a western Kenya papyrus swamp is specialized with low species diversity indices and few species compared to other west Kenya habitats. Interspecific competition between similar sized species of warblers, a group which dominates the avifauna, is reduced by preference for swamp edge rather than interior habitats, preference for papyrus over standing water, or vertical habitat partitioning. Density figures for common species are higher than in forest undergrowth or thickets. This fact may be interpreted as density compensation on a species-poor 'island' compared to a species-rich 'mainland'. There is a modal egg-laying period from March to June coinciding with the long rains, and a post-nuptial primary moult period from June to November which extends into the short rain period. Breeding and moult schedules therefore occupy about eight months and may be readily accommodated in the wetter months of the year. The timing of moult is apparently more synchronized and less haphazard than breeding. Post-nuptial moult commenced earlier in a year where the long rains were early. There is little evidence of interrupted moult. Moult schedules are suggested as more flexible in females. (Howard-Mass)  
W80-03508

**SPARTINA ALTERNIFLORA SEED FUNGI,**  
North Carolina Univ. at Morehead City. Inst. of Marine Sciences.  
R. V. Gessner.  
Canadian Journal of Botany, Vol 56, No 23, p 2942-2947, December 1, 1978. 2 Tab, 27 Ref.

Descriptors: \*Salt marshes, \*Fungi, \*Aquatic plants, \*Seeds, \*Decomposition, Microorganisms, Ecological distribution, Wetlands, Marshes, Estuaries, Ecology, Life history studies, North Carolina.

Filamentous fungi species occurring on *Spartina alterniflora* seeds submerged in estuarine waters or on salt-marsh sediments in North Carolina included eight Ascomycetes, one Basidiomycete, and 16 Fungi Imperfecti. Marine fungi primarily known as wood-inhabiting species were among the fungi found after two months on the marsh surface or in the adjacent sound and tidal creek. This suggests a role as general decomposers of plant debris in marine habitats for these fungi. After 5 to 7 months, marine fungi and graminicolous Ascomycetes were the only fungi found by direct observation, although seed-borne species commonly found on grain crops could still be isolated by incubation methods. The seeds were completely degraded or barely recognizable after 11 months on the marsh sediments or in sea water. Claviceps purpurea parasitized the seed heads at all the marsh areas sampled. The greatest number of sclerotia were found on the tall *S. alterniflora* near the lower edge of the marsh in exposed areas and on inflorescences from dredge spoil areas. Up to 183 sclerotia/sq m and sclerotia dry weight values of up to 2.72 g/sq m were found. (Howard-Mass)  
W80-03509

**MARSH NESTING BY MALLARDS,**  
Fish and Wildlife Service, Jamestown, NC. Northern Prairie Wildlife Research Center.  
G. L. Krapu, L. G. Talent, and T. J. Dwyer.  
Wildlife Society Bulletin, Vol 7, No 2, p 104-110, Summer, 1979. 2 Fig, 1 Tab, 27 Ref.

Descriptors: \*Mallard duck, \*Nesting, \*Freshwater marshes, Life history studies, Waterfowl, Nesting cover, Wetlands, Aquatic vegetation, Marshes, Ecology, Wildlife, Habitat, Wildlife management, Potholes.

Sixty-six percent of 53 nest initiated by radio-marked and unmarked mallard hens in a region of the Missouri Coteau in southcentral North Dakota were in wetlands in dense stands of emergent vegetation. Nests were usually within 50 m of the wetland edge. Potential factors contributing to mallard use of marsh habitat for nesting include: better access to tall residual cover at wetland sites

than in uplands in early spring; the fact that water is a deterrent to some mammalian predators; and the longer survival length of marsh nests. It remains to be determined whether marsh nesting mallards are a distinct subgroup or if individuals nest interchangeably at marsh and upland sites, and whether imprinting is involved in the habitat selection process. Nesting requirements of mallards at marsh sites should be reconciled with other breeding requirements of this species and needs of other waterfowl before implementing wetland habitat management programs that would favor development of marsh nesting cover at the expense of other important habitat needs. (Howard-Mass)  
W80-03510

**SEASONAL AND SPATIAL CHANGES IN THE COMPOSITION OF THE AQUATIC AND SEMIAQUATIC VEGETATION OF LAKE CHILWA, MALAWI,**  
Lake Chilwa Research Project, Limbe (Malawi).  
C. Howard-Williams.  
Vegetatio, Vol 30, No 1, p 33-39, March 10, 1975. 2 Fig, 2 Tab, 20 Ref.

Descriptors: \*Freshwater marshes, \*Lakes, \*Aquatic plants, \*Ecological distribution, Marshes, Wetlands, Spatial distribution, Seasonal, Africa.

Changes in the frequency of individual species and in species composition of the vegetation were monitored at monthly intervals at four stations on the shore of Lake Chilwa. The stations formed a transect from land to lake through the littoral Typha swamp. Stand distance indices decreased from land to lake, while species diversity decreased from land to the central swamp and then rose again on the lake edges. Seasonal changes in the vegetation were more pronounced on the landward edge, which was subjected to alternate wet and dry periods, than in the vegetation of the lake edge. It is suggested that plant communities occurring in a fluctuating physical environment may behave differently with respect to diversity from those in which the environment is temporally stable. (Howard-Mass)  
W80-03512

**ECOLOGY OF WATER-LEVEL MANIPULATIONS ON A NORTHERN MARSH,**  
Humboldt State Univ., Arcata, CA.  
S. W. Harris, and W. H. Marshall.  
Ecology, Vol 44, No 2, p 331-343, Spring, 1963. 3 Fig, 3 Tab, 39 Ref.

Descriptors: \*Freshwater marshes, \*Drawdown, \*Aquatic plants, \*Vegetation effects, Marshes, Water level fluctuations, Wetlands, Ecology, Ecological distribution, Minnesota, Plant growth, \*Agassiz National Wildlife Refuge(MN).

Vegetation changes associated with marsh drawdowns at Agassiz National Wildlife Refuge, Minnesota, indicate that the development of five types of vegetation on mud flats during the first year was influenced by seed availability, soil type and moisture, season and duration of drawdown, and the amount of stranded algal debris. The more an area combined early season drawdown, rich soil types, slow rates of mud flat drainage, and small amounts of stranded algae, the greater was the development of emergent aquatics. In the second year of drawdown, most areas developed greater amounts of upland and shoreline weeds and fewer emergents. Areas originally exposed before August of the first year lost emergent cover during the second year, while the reverse was true of areas exposed later in the first year. Over a 5-year drawdown, nearly solid stands of willow developed. Upon reflooding, mud flats and shoreline annuals were eliminated and emergents and aquatic annuals developed in the first year. Depending on water depths and cover types, 1- or 2-year drawdowns at 5- to 10-year intervals are required to maintain emergent marshes at this refuge. (Howard-Mass)  
W80-03515

**THE EFFECT OF THE MARSH ELDER (IVA FRUTESCENS) ON THE STANDING CROP BIOMASS OF SPARTINA PATENS AND ASSOCIATED WILDLIFE,**

## Field 2—WATER CYCLE

### Group 21—Water in Plants

New Jersey Agricultural Experiment Station, New Brunswick.  
J. K. Shisler, T. L. Schulze, and B. L. Howes.  
Biological Conservation, Vol 14, No 3, p 159-166, November, 1978. 5 Fig, 3 Tab, 29 Ref.

Descriptors: \*Saltmarshes, \*Trees, \*Dredging, \*Environmental effects, \*Wildlife habitats, Rooted aquatic plants, Wildlife, Birds, Mammals, Nesting cover, Habitat, Wetlands, New Jersey, Standing crop, Biomass, Organic matter, Ecosystem.

Leaf and wood biomass were highly correlated with age in a population of *Iva frutescens* L. associated with *Spartina patens* (Ait.) Muhl on dredged material piles in a New Jersey saltmarsh which was previously managed for mosquito control. Living biomass of *S. patens* on the marsh surface, on dredged material piles and on dredged material piles with *I. frutescens* growth were not statistically different. Standing dead biomass of *S. patens* on the dredged material piles with *I. frutescens* was significantly lower than dead *S. patens* biomass on the marsh surface and dredged material, piles without *I. frutescens*. This was probably a result of increased tidal circulation in the managed marsh. In addition to contributing organic material to the saltmarsh-estuarine ecosystem without causing any detrimental effects on the standing crop biomass of *S. patens*, *I. frutescens* was shown to provide nesting and foraging sites for various species of birds, and islands of refuge for small animals and birds. (Howard-Mass)  
W80-03516

**ASSESSMENT OF EFFECTS OF ALTERED STREAM FLOW CHARACTERISTICS ON FISH AND WILDLIFE. PART B: CALIFORNIA, CASE STUDIES.**  
Jones and Stokes, Inc., Sacramento, CA.  
For primary bibliographic entry see Field 6G.  
W80-03517

**BIOGENIC STRUCTURE AND ITS EFFECT ON THE SPATIAL HETEROGENEITY OF MEIOFAUNA IN A SALT MARSH.**  
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research. S. S. Bell, M. C. Watzin, and B. C. Coull.  
Journal of Experimental Marine Biology and Ecology, Vol 35, No 2, p 99-107, November, 1978. 2 Fig, 2 Tab, 25 Ref.

Descriptors: \*Salt marshes, \*Microorganisms, \*Spatial distribution, \*Rooted aquatic plants, Aquatic animals, Crabs, Burrows, Environmental effects, Wetlands, Marshes, Root systems, Biomass, Ecology, Habitat, South Carolina.

Meiofauna samples collected around and between *Spartina* plants in the North Inlet estuarine system of South Carolina had either negative correlations with root biomass or no correlation. If, as predicted by earlier workers, meiofauna are attracted to micro-oxygenated zones around roots, there should have been a positive association between meiofauna and roots. Nematodes had higher densities around fiddler crab burrows than in controls, but copepods were less abundant. Biogenic structures significantly affect meiofauna distribution and must be taken into account when quantifying meiofauna in areas with much structural heterogeneity. (Howard-Mass)  
W80-03519

**THE IMMEDIATE EFFECTS OF DITCHING A SALT MARSH ON NESTING HERRING GULLS *LARUS ARGENTATUS*.**  
Livingston Coll., New Brunswick, NJ. Dept. of Biology.  
For primary bibliographic entry see Field 4A.  
W80-03520

**SPECIES VERSATILITY IN SHORE HABITATS.**  
Harvard Univ., Petersham, MA. Harvard Forest. H. M. Raup.  
Journal of the Arnold Arboretum, Vol 56, p 126-163, 1975. 14 Fig, 2 Tab, 41 Ref.

Descriptors: \*Shores, \*Marsh plants, \*Distribution patterns, Lakes, Wetlands, Aquatic plants, Freshwater marshes, Muskeg, Aquatic habitats, Mosses, Spatial distribution, Canada, \*Athabaska-Great Slave Lake region(Canada).

This study deals with the shore vegetation of lakes and rivers in the Athabaska-Great Slave Lake region of northwestern Canada. Ten habitat-vegetation complexes are defined to embrace the principal variations that were found: (1) aquatic habitats, with submerged and/or emergent plants; (2) saline or brackish sloughs or wet meadows; (3) muskeg grass-sedge meadows; (4) open shrub muskeg; (5) shrub-tree borders of muskeg; (6) lower beaches on large lakes; (7) upper beaches on large lakes; (8) grass-sedge meadows on river flood plains; (9) shrub-tree borders on meadows; and (10) herbs or trailing shrubs on middle beaches of large lakes. Within the habitats, the vegetation is described in terms of assemblages of vascular plant species which are visibly different from one another owing to the abundance and/or prominence of one or more 'primary' species. (Steiner-Mass)  
W80-03521

**VEGETATION AND NUTRIENT STATUS OF NORTHERN MICHIGAN FENS.**  
Michigan Univ., Pellston. Biological Station. C. R. Schwintzer.  
Canadian Journal of Botany, Vol 56, No 24, p 3044-3055, December 15, 1978. 2 Tab, 26 Ref.

Descriptors: \*Fen, \*Vegetation, \*Nutrients, \*Distribution, Bogs, Marshes, Wetlands, Michigan, Water level, Calcium, Mineral water, Hydrogen ion concentration, Ecological distribution, Ecology.

The field layer was the dominant stratum in 5 northern Lower Michigan fens. This stratum contained a total of 85 vascular species with a mean density of 30 vascular species per stand. *Carex lasiocarpa* was the most prevalent dominant plant and attained a frequency-presence index (FPI) of 8000 of a possible 10,000 and a mean important value of 33 of a possible 200. Other common dominants in decreasing order of FPI were *Carex aquatilis* (6640), *Myrica gale* (4636), and *Andromeda glaucophylla* (2000). Common subordinates were *Hypericum virginicum* (2639), *Muhlenbergia glomerata* (2466), and *Campanula aparinoides* (1400). The homogeneity index for the five fens had a value of 58%. The shallow groundwaters were minerotrophic with pH values ranging from 5.7 to 7.0 and calcium concentrations of 11.0 to 75.0 mg/l. Four of the fens were on floating mats and had relatively stable water levels while the fifth was on a grounded mat and was subject to substantial water level fluctuation. Three previously described alkaline lake-edge kettle-hole 'bog' communities were found to be similar to the fens in species composition and water chemistry. (Howard-Mass)  
W80-03523

**PRODUCTION AND STRUCTURE IN THE EARLY STAGES OF VEGETATION DEVELOPMENT IN THE LAUWERSZEE-POLDER.**  
Groningen Rijksuniversiteit (Netherlands). Afdeling Plantenecologie.  
For primary bibliographic entry see Field 2L.  
W80-03524

**A PALAEOECOLOGICAL STUDY OF HOLOCENE PEAT BOG SECTIONS IN GERMANY AND THE NETHERLANDS, BASED ON THE ANALYSIS OF POLLEN, SPORES AND MACRO- AND MICROSCOPIC REMAINS OF FUNGI, ALGAE, CORMOPHYTES AND ANIMALS.**  
Amsterdam Univ. (Netherlands). Hugo de Vries Lab.  
For primary bibliographic entry see Field 2H.  
W80-03525

**VEGETATION STUDY UNDERTAKEN AT THE LAMTO SAU SAVANNA RESERVE (IVORY COAST)—(VEGETATIONSKUNDLICHE UNTERSUCHUNGEN IM SAVANNENRESERVAT LAMTO (ELFENBEINKUSTE)).**

Geottingen Univ. (Germany, F.R.). Lehrstuhl fuer Geobotanik.  
W. Schmidt.  
Vegetatio, Vol 28, No 3-4, p 145-200, September 28, 1973. 5 Fig, 5 Tab, 26 Ref, 1 Append. (English summary).

Descriptors: \*Freshwater marshes, \*Vegetation, \*Ecological distribution, \*Grasslands, Wetlands, Marshes, Ecology, Soil moisture, Africa.

The vegetation of the Lamto Savanna Reserve in the Ivory Coast is classified into four major plant communities on the basis of phytosociological records. The *Loudetia phragmitoides*-swamp community with its two subdivisions occurs in depressions and is influenced by waterlogging during the rainy season. During the dry season, these sites are burned by bush fires. Life-form spectrum of Savanna vegetation show a marked competition between hemiepiphytes and phanerophytes. Chamaephytes dominate in rock vegetation, therophytes in swamps and phanerophytes in forest stands. (Howard-Mass)  
W80-03527

**MIRE OF THE MANAPOURI-TE ANAU LOWLANDS.**  
Canterbury Univ., Christchurch (New Zealand). Dept. of Botany.  
C. J. Burrows, and A. T. Dobson.  
Proceedings of the New Zealand Ecological Society, Vol 19, p 75-99, 1972. 18 Fig, 15 Tab, 21 Ref, 3 Append.

Descriptors: \*History, \*Wetlands, \*New Zealand, Succession, Marsh plants, Aquatic plants, Marshes, Freshwater marshes.

Lakes Manapouri and Te Anau lie on the eastern margin of the hard rock highland of Fiordland, New Zealand, their basins partially surrounded by steep mountainsides. There are extensive areas of wetlands around the southeastern ends of the lakes. The wetlands have arisen mainly on landforms resulting from the widespread glaciation of the area. The vegetational history of the area is discussed and the origins, general form, margin profile, surface form, stratigraphy, and the vegetational physiognomy of a few individual mires are described. (Steiner-Mass)  
W80-03528

**AVIAN ECOLOGY OF A MANAGED GLACIAL MARSH.**  
M. W. Weller, and L. H. Fredrickson.  
In: The Living Bird, Twelfth Annual of the Cornell Laboratory of Ornithology, Cornell University, Ithaca, New York, p 269-291, 1973. 16 Fig, 7 Tab, 13 Ref.

Descriptors: \*Freshwater marshes, \*Habitat, \*Birds, \*Marsh management, \*Environmental effects, Water levels, Vegetation establishment, Succession, Vegetation effects, Muskrats, Wildlife management, Marshes, Wetlands, Drawdown, Ecology, Ecosystem, Iowa.

Bird populations in a semipermanent glacial marsh in northern Iowa changed dramatically when water levels were lowered to initiate revegetation and then regulated to maintain maximal use by birds and muskrat. The greatest avian number and species diversity were present when 50 to 70 percent of the open water was well interspersed with vegetation. The general pattern of short-term vegetation-bird succession in this type of marsh is: (1) sparse germination of diverse plant species, which may attract many birds when flooded, (2) an increase in density of perennial emergents to form a dense marsh less attractive to birds, (3) an increase in open water resulting from use of the vegetation by muskrat with a resulting increase in numbers and species of birds in the well-interspersed hemi-marsh, until (4) emergent vegetation is eliminated in the central marsh by muskrat and water levels, and bird populations are reduced to those species using the marsh edge. Such successional changes are not permanent but reflect the dynamic changes of an unstable ecosystem. (Howard-Mass)

## Erosion and Sedimentation—Group 2J

W80-03529

## STUDIES ON THE MICRO-FAUNA OF BLANKET BOG WITH PARTICULAR REFERENCE TO ENCHYTRAEIDAE. I. FIELD AND LABORATORY TESTS OF MICRO-ORGANISMS AS FOOD.

Nature Conservancy, Alston (England). Moor House Field Station.

J. A. Springett, and P. M. Latter.

Journal of Animal Ecology, Vol 46, p 959-974, 1977. 1 Fig, 6 Tab, 26 Ref, 1 Append.

Descriptors: \*Food habits, \*Aquatic microorganisms, \*Bogs, Aquatic animals, Wetlands, Worms, Biomass, Secondary productivity, Food chains, Productivity.

As part of a project to study primary and secondary production in a moorland ecosystem, the importance of microorganisms in the food of Enchytraeidae was investigated in field and laboratory experiments. The field experiments used two field baiting techniques and included records of other soil fauna. The laboratory experiments tested the growth of the dominant enchytraeid worm, *Cognettia sphagnetorum*, in microbial cultures. The studies provided no firm evidence that microorganisms form any part of the natural diet of moorland Enchytraeidae, but the use of soluble nutrients is a possibility. (Steiner-Mass)

W80-03531

## NUTRIENT AND PARTICULATE FLUXES IN A SALT MARSH ECOSYSTEM: TIDAL EXCHANGES AND INPUTS BY PRECIPITATION AND GROUNDWATER.

Marine Biological Lab., Woods Hole, MA. Boston Univ. Marine Program.

I. Valiela, J. M. Teal, S. Volkman, D. Shafer, and E. J. Carpenter.

Limnology and Oceanography, Vol 23, No 4, p 798-812, July, 1978. 9 Fig, 7 Tab, 40 Ref.

Descriptors: \*Salt marshes, \*Cycling nutrients, \*Precipitation, \*Groundwater, Nutrients, Phosphorus, Nitrogen, Carbon, Tidal water, Wetlands, Marshes, Aquatic plants, Ecosystem, Ecology, Organic matter.

Waterborne nutrients enter Great Sippewissett Marsh in Massachusetts through groundwater, rain, and tidal flooding. The ebb of tidal water removes nutrients. During summer, uptake by marsh biota leads to net import of nutrients. The increased export of ammonium in August may be due to leaching from senescent marsh plants. There is a net annual export of ammonium, nitrate, nitrite, dissolved organic (DON) and particulate (PN) nitrogen, particulate carbon (PC), and phosphate. Ammonium, DON, and PN are the major forms of nitrogen exported. Nutrient concentrations in coastal and marsh water are correlated, and marsh exports could contribute substantially to nutrient supplies of coastal waters. Groundwater entering the marsh provides primarily  $\text{NO}_3\text{-N}$  and DON. Nutrient inputs through precipitation consist primarily of DON,  $\text{NO}_3\text{-N}$ , and  $\text{NH}_4\text{-N}$ . Groundwater carries over 20 times the amount of nutrients brought in by rain; therefore, nitrogen inputs from this source are important to the nitrogen economy of a salt marsh. About half the dissolved inorganic nitrogen brought into the marsh by groundwater is converted to and exported as PN, a form suitable for consumers. PC exported to coastal water is equivalent to 40% of the net annual production of *Spartina alterniflora*, the dominant marsh plant. (Howard-Mass)

W80-03532

## THE CONTRIBUTION OF MACROPHYTES TO THE METALIMNETIC OXYGEN MAXIMUM IN A MONTANE, OLIGOTROPHIC LAKE.

Virginia Univ., Charlottesville. Dept. of Biology. C. I. Dubay, and G. M. Simmons, Jr.

American Midland Naturalist, Vol 101, No 1, p 108-117, 1979. 5 Fig, 2 Tab, 29 Ref.

Descriptors: \*Lakes, \*Rooted aquatic plants, \*Dissolved oxygen, Virginia, Aquatic plants, Oxygen,

Ecology, Stratification, Hypolimnion, Distribution patterns, Ecological effects, Standing crop.

Dense beds of rooted macrophytes, primarily *Nitella flexilis*, grow around the circumference of the lake to a depth of 11 m. There was no correlation between the positive heterograde oxygen curve and limnetic phytoplankton density or estimates of primary productivity. The strongest association existed between the metalimnetic oxygen maximum and the standing crop dry weights of the macrophyte community. All transects across the macrophyte beds indicated the greatest standing crop to be between depths of 6 to 10 m. Variation in total standing crop between transects is attributed to slope angle of the basin, substrate, and direction of slope, in order of importance. (Steiner-Mass)

W80-03533

## EFFECTS OF OFF-ROAD VEHICLES ON PLANTS OF A NORTHERN MARSH.

Massachusetts Univ., Amherst.

For primary bibliographic entry see Field 4C.

W80-03536

## VEGETATION ZONATION AROUND FRESH-WATER SPRINGS OF THE MAHARLU SALT LAKE NEAR SHIRAZ (IRAN), VEGETATIONSZONIERUNG AN SUSSWASSERQUELLEN DES MAHARLUSALZSEES BEI SHIRAZ (IRAN).

Tuebingen Univ. (Germany, F.R.). Lehrbereich fuer Spezielle Botanik.

W. Frey, and W. Probst.

Vegetatio, Vol 29, No 2, p 109-114, November 25, 1974. 5 Fig, 12 Ref. (English summary).

Descriptors: \*Salt marshes, \*Aquatic plants, \*Ecological distribution, \*Saline lakes, \*Salt tolerance, Ecology, Spatial distribution, Wetlands, Marshes, Iran.

Spatial distribution of vegetation types around three freshwater sources of the salt lake Maharlu in S. Iran is a function of decreasing salinity within the delta-like area between the lake border and the sources. *Juncus maritimus* dominates on the saline soils of the lake shore. This species is replaced by *Aeluropus lagopoides* on soils influenced by freshwater. Freshwater species such as *Potamogeton pusillus* and *Spirogyra fluvialis* establish near the sources. Between the drainage streams of the sources and the shoreline, *Cyperus laevigatus* dominates. Within this zone three subzones can be distinguished. Species like *Spirogyra fluvialis* are found nearest the source with a compact mat of *Chara tomentosa* occurring farther away. The third subzone, which consists of *Cyperus laevigatus* with *Mougeotia cf. crassa* and blue algae, precedes the final *Salicornia* zone, dominated by *Salicornia europaea* and *Spergularia marina*. (Howard-Mass)

W80-03537

## TRICKLE IRRIGATION TIMING AND ITS EFFECT ON PLANT AND SOIL WATER STATUS.

Ben Gurion Univ. of the Negev, Beersheba (Israel). Inst. of Desert Research.

For primary bibliographic entry see Field 3F.

W80-03545

## ARID LANDS BIOMASS PRODUCTION IN ARIZONA.

Arizona Univ., Tucson. Office of Arid Lands Studies.

K. E. Foster.

Arizona Water Resources Project Information, Project Bulletin No 22, Dec 1979. 3 p, 3 Fig, 3 Tab, 10 Ref.

Descriptors: \*Tumbleweed, \*Crop production, \*Alternative planning, \*Efficiencies, \*Fuels, Economic feasibility, Biomass, Consumptive use, Energy conversion, Water conservation, Environmental effects, Arizona.

Although more than 3 million hectares (ha) of land in Arizona are available for crop production, only

slightly more than 0.5 million ha are farmed each year due to the absence of dependable and inexpensive water supplies. An alternative for Arizona's agricultural economy is to cultivate crops that grow naturally in arid and semiarid climates, for example the common Russian thistle or tumbleweed (*Salsola kali*) which has very high water-use to biomass-produced efficiencies. Although cultivation of tumbleweed, a high energy content plant suitable for biomass-derived fuels, involves considerable amounts of land, it appears that water conservation, energy, economic, and environmental gains are greater than the costs, particularly since retired agricultural lands are available for economic use, and agriculture could be restored to those communities where it has been the prime source of revenue but has been declining due to lack of inexpensive water. (Tickes-Arizona)

W80-03546

## 2J. Erosion and Sedimentation

## TRACE ELEMENT RELEASE FROM ESTUARINE SEDIMENTS OF SOUTH MOSQUITO LAGOON NEAR KENNEDY SPACE CENTER, SAVANNAH STATE COLL., GA.

For primary bibliographic entry see Field 5A.

W80-03355

## TRACER STUDY OF SEDIMENT-WATER INTERACTIONS IN ESTUARIES.

Rhode Island Univ., Kingston. Graduate School of Oceanography.

N. A. Luedtke, and M. L. Bender.

Estuarine and Coastal Marine Science, Vol 9, No 5, p 643-651, November 1979. 5 Fig, 4 Tab, 14 Ref.

Descriptors: \*Sediments, \*Estuaries, \*Sediment-water interfaces, \*Tracers, Isotope studies, Radiosotopes, Pore water, Earth-water interfaces, Benthic fauna, On-site investigations, Sampling, Model studies, Mathematical models, Sedimentology, Biology, \*Narragansett Bay(RI), Sediment-water interactions, Water exchange.

Rates of sediment bioturbation and advective exchange of water across the sediment-water interface in Narragansett Bay, Rhode Island, were studied by radioactive tracer experiments. The "biological pumping rate" of water across the interface ( $0.7 \pm 0.3 \text{ cu cm/sq cm/day}$ ) was calculated from a two box model in which the decrease in  $^{22}\text{Na}$  concentration in water overlying a box core was ascribed to animal pumping of water across the sediment-water interface. The "diffusion coefficient" of solid sediment was determined to be  $3 \times 10^{-10}$  to the minus 7th power  $\text{sq cm/s}$  from the depth distribution at the end of the experiment of  $^{141}\text{Ce}$  tagged microspheres and  $^{59}\text{Fe}$  (which was quantitatively scavenged onto particles at the start of the experiment). The pore water profile determined for  $^{54}\text{Mn}$  in the cores was similar to stable Mn profiles previously determined for the site. Of the radioisotopes added to the water overlying the box core, nearly 100% of the Na and 50% of Sr remained in solution, while only 10% of the Ba, Mn, and Hg and less than 1% of the Cd, Zn, and Fe remained in solution when the experiments were terminated. (Sims-ISWS)

W80-03368

## MINOR ELEMENTS IN THE SEDIMENTS OF THE THAMES ESTUARY.

Thames Water Authority, London (England). Directorate of Scientific Services.

L. A. Nelson.

Estuarine and Coastal Marine Science, Vol 9, No 5, p 623-629, November 1979. 3 Fig, 4 Tab, 13 Ref.

Descriptors: \*Trace elements, \*Sediments, \*Suspended solids, \*Estuaries, Sampling, Chemical analysis, Neutron activation analysis, Heavy metals, Chemicals, Tidal waters, Coasts, Rivers, Sedimentation, Sedimentology, \*England, \*Thames Estuary(England), Resuspended sediments.

Concentrations of Ce, Th, Cr, Hf, Cs, Sc, Fe, Co, and Eu were determined in the suspended particu-

## Field 2—WATER CYCLE

### Group 2J—Erosion and Sedimentation

late matter and sediments of the Sea Reach area of the Thames Estuary using instrumental neutron activation analysis. Element-scandium relationships in the materials indicated a difference in composition of the suspended matter to the sediment, and it was suggested that the suspended matter represents resuspended fine grained detrital sediment. The observed hafnium enrichment in the sediment was discussed in relation to this. (Sims-ISWS) W80-03370

#### SEASONAL SHIFTS OF SEDIMENT WITHIN AN ESTUARY MEDIATED BY ALGAL GROWTH

Birkbeck Coll., London (England). Dept. of Geology. L. E. Frostick, and I. N. McCave. Estuarine and Coastal Marine Science, Vol 9, No 5, p 569-576, November 1979. 4 Fig, 1 Tab, 16 Ref.

Descriptors: \*Mudflats, \*Estuaries, \*Algae, \*Sediments, Coasts, Deposition(Sediments), Erosion, Euglenophyta, Biology, Effects, Sedimentation, Sedimentology, \*England, \*East Anglia(England).

Measurements of the level of mud flats in the Deben estuary (Suffolk, England) show seasonal change with accretion of about 5 cm between April and September during algal growth, and erosion of that amount during autumn and winter when algae are dead or absent. Although some seasonal change might occur in the absence of algae, the rates of deposition involved require that erosion be inhibited and sedimentation be maximized from the available suspensions. In this, the binding and baffling activity of algae was apparent. The total amount of deposition on the flats (100,000 tons) was far more than can be supplied from the river or the sea, and transfer between the channel banks and the tidal flats on a seasonal basis was postulated. (Sims-ISWS) W80-03374

#### THE DETERMINATION OF ESTUARINE SEDIMENTATION RATES BY <sup>134</sup>CS/<sup>137</sup>CS AND OTHER ARTIFICIAL RADIONUCLIDE PROFILES

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences. S. R. Aston, and D. A. Stanners. Estuarine and Coastal Marine Science, Vol 9, No 5, p 529-541, November 1979. 4 Fig, 5 Tab, 41 Ref.

Descriptors: \*Sedimentation rates, \*Estuaries, \*Isotope studies, \*Radioisotopes, Profiles, Sediments, Sedimentation, Radioactive dating, Sampling, Cores, Data processing, Sedimentology, \*England.

The profiles of <sup>137</sup>Cs, <sup>134</sup>Cs, <sup>106</sup>Ru, <sup>144</sup>Ce, <sup>95</sup>Zr/<sup>Nb</sup>, and the <sup>134</sup>Cs/<sup>137</sup>Cs ratio in a sediment core and their discharge patterns from the Windscale Nuclear Plant were used to determine the net sedimentation rate on an estuarine intertidal bank. The use of multiradionuclide and <sup>134</sup>Cs/<sup>137</sup>Cs ratio profiles suggested that previous single radionuclide profiles which have been used for sedimentation rate determinations may be subject to errors. Apparent diffusion coefficients were used in a modification of Lerman's model to correct the input pattern of the radionuclides for postdepositional migration. A comparison of the corrected profiles with the observed profiles suggested that the vertical distribution of radionuclides is not significantly altered after deposition and closely relates to the discharge pattern. The multiradionuclide discharge patterns and sediment profiles indicated that the net sedimentation rate is in the range 50-80 mm/year, while the <sup>134</sup>Cs/<sup>137</sup>Cs ratio data gave a more reliable estimate of 67 mm/year. (Sims-ISWS) W80-03377

#### A PREDICTIVE MODEL OF SEDIMENT TRANSPORT IN LAKE MICHIGAN BASED UPON CLAY MINERALOGY

Michigan State Univ., East Lansing. Dept. of Natural Science. G. P. Merk. Available from the National Technical Information

Service, Springfield, VA 22161 as PB80-147275. Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, January 1980. 14 p, 1 Fig, 3 Tab, 4 Ref. OWRT A-093-MICH(1).

Descriptors: \*Lake Michigan, \*Clay minerals, \*Sediment transport, \*Water pollution sources, Sediments, Illite, Kaolinite, Particle size, Suspended solids, Deposition(Sediments), Bottom sampling, Laboratory tests, Soil analysis, Assay.

Clay minerals present in the sediments of rivers emptying into southern Lake Michigan and those present in the surficial sediment of southern Lake Michigan (Waukegan Member) were studied to develop a model of sediment transport for that area of the lake. It appears that man-made pollutants from areas around the lake are being concentrated in the clays and sediment of this area. Rivers sampled include the St. Joseph, the Black, the Kalamazoo, the Grand, and the Muskegon. Each river was sampled three times using a depth integrating water sample to collect about 15 gallons per sample. The samples were treated in the laboratory to identify the various clay minerals which included illite, kaolinite, chlorite, and vermiculite. Peak height values were also calculated from x-ray diffractograms of the clay fraction of the samples and were used to develop the geographic pattern of clay mineral variations in the rivers. Samples from six locations in the Waukegan Member were also analyzed in the laboratory and diffractograms were made. Comparisons of clay mineral peak height ratios on the diffractograms do not show any pattern of lateral variation between the six stations sampled. Also the ranking order of clay minerals found for the Waukegan Member are consistent for the stations sampled. This uniformity and the existence of sand at all sites suggests a lakewide current system producing much sediment dispersion, mixing, and resuspension. (Seigler-IPA) W80-03382

#### METHOD MEANS FOR DE-SILTING WATER

For primary bibliographic entry see Field 5G. W80-03410

#### AGGRADATION IN STREAMS DUE TO OVERLOADING

Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering. J. P. Soni, R. J. Garde, and K. G. Ranga Raju. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY1, Proceedings Paper 15147, p 117-132, January 1980. 12 Fig, 14 Ref, 2 Append.

Descriptors: \*Alluvial channels, \*Aggradation, \*Mathematical models, Hydraulics, River beds, Sediment transport, Rivers, Sedimentation, Sediment load, Equations, Streams, Flumes, Flow, \*Stream overloading, Sediment characteristics.

The problem of aggradation due to increase in the rate of sediment supply in excess of what the stream can carry has been investigated. The supply of sediment is assumed to be continuous and at a constant rate. A relationship for the depth of aggradation at any time and at any distance from the section of sediment addition has been developed. Since the mathematical model used was based on many simplifying assumptions, it needed verification against a known set of data. Experiments were, therefore, performed in the laboratory, and these have enabled suitable modification of the analytical results. (Lee-ISWS) W80-03452

#### EFFECTS OF OFF-ROAD VEHICLES ON THE SEDIMENTS OF HATCHES HARBOR, CAPE COD NATIONAL SEASHORE

Massachusetts Univ., Amherst. Dept. of Geology. For primary bibliographic entry see Field 4C. W80-03535

## 2K. Chemical Processes

#### GEOLOGY AND GEOCHEMISTRY OF THE SHIP CREEK AND MONASHKA CREEK RESERVOIRS, SOUTHCENTRAL ALASKA

Alaska Univ., Fairbanks. Inst. of Water Resources. D. B. Hawkins, and G. L. Nelson. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143654. Price codes: A05 in paper copy, A01 in microfiche. Report No IWR-71, 1976. 70 p, 12 Fig, 8 Tab, 16 Ref, 8 Append, OWRT A-045-ALAS (1), 14-31-0001-5002.

Descriptors: \*Hydrogeology, \*Geochemistry, \*Water chemistry, \*Alaska, Streams, Water quality, Soil chemistry, Solubility, Leaching, Soluble rocks, Graywacke, \*Ship Creek(Alaska), \*Monashka(Alaska).

Graywacke from the Ship Creek watershed dissolves incongruently in distilled water. The dissolution appears to follow a first-order rate law, which is developed along with experimentally derived rate constants for this dissolution. A surface area correction term must be inserted in this equation if it is applied to a different size fraction. Using equation and rate constants, the chemical composition of a water in contact with graywacke was calculated. With the exception of magnesium, there was good agreement between the calculated composition and that of Ship Creek water. Assuming that the groundwater in the Ship Creek watershed contacts about 1500 cc graywacke per liter, 120 to 360 days are required at 5°C to produce the concentration of ions observed in Ship Creek. Release of exchangeable hydrogen ions from the soil to the reservoir water will not significantly lower the pH of the water. Leaching of heavy metals from sulfides contained in the bedrock of the two watersheds does not pose a water quality hazard. Lineaments in the bedrock at Monashka Creek may provide channels through which water may seep from the reservoir. These are not expected to pose a problem in retaining water in the reservoir, but these may result in small, new springs down grade from the reservoir. (Paulson-Alaska) W80-03304

#### MODIFIED AMPEROMETRIC MEMBRANE PROBES FOR DETERMINING FREE AND TOTAL RESIDUAL CHLORINE IN SALINE COOLING WATERS

Central Electricity Generating Board, Leatherhead (England). Research Labs. For primary bibliographic entry see Field 5A. W80-03462

## 2L. Estuaries

#### ON MAN-INDUCED VARIATIONS IN THE CIRCULATION OF THE MEDITERRANEAN SEA

Miami Univ., FL.; and National Oceanic and Atmospheric Administration, Miami, FL.; and Cooperative Inst. for Marine and Atmospheric Studies, Miami, FL. D. Nof. Tellus, Vol 31, No 6, p 558-564, December 1979. 2 Fig, 13 Ref. NSF ATM-28126, ATM75-22940.

Descriptors: \*Circulation, \*Water circulation, \*Salinity, \*Diversion, Rivers, Runoff, Mixing, Evaporation, Inflow, Model studies, Mathematical models, Oceanography, \*Mediterranean Sea, \*Straits of Gibraltar, \*Nile River, River diversion.

The response of the Mediterranean Sea to a diversion of rivers, such as the Nile, for agricultural use, was investigated by a simplified dynamical model for the Mediterranean basin. Solutions were obtained by using the principle of 'hydraulic control' at the Straits of Gibraltar, volume and salinity conservations, and perturbation techniques. It was found that such a diversion causes an increase of salinity in the basin and alters the exchange between the Mediterranean Sea and the Atlantic Ocean. The predicted result was an increase in the transport through the Straits of Gibraltar. This

## Estuaries—Group 2L

increase of both the transport into and from the Mediterranean is about eight times larger than the amount of water which is diverted and is expected to take place within 25-50 years after the diversion. For the Nile alone, which has been diverted in the mid-1960s, an increase of approximately 0.5% in the transport through the Gibraltar Straits will occur, and if all runoff flowing into the Mediterranean Sea was to be diverted, an increase of approximately 3.5% will take place. (Sims-ISWS) W80-03354

#### TRACE ELEMENT RELEASE FROM ESTUARINE SEDIMENTS OF SOUTH MOSQUITO LAGOON NEAR KENNEDY SPACE CENTER, Savannah State Coll., GA.

For primary bibliographic entry see Field 5A. W80-03355

#### HYPSOMETRY OF THE CONTINENTAL SHELF OFF EASTERN NORTH AMERICA, Woods Hole Oceanographic Institution, MA. K. O. Emery.

Estuarine and Coastal Marine Science, Vol 9, No 5, p 653-658, November 1979. 3 Fig, 2 Tab, 8 Ref.

Descriptors: \*Hypsometric analysis, \*Continental shelf, \*Atlantic Ocean, \*Gulf of Mexico, \*North America, \*Bathymetry, \*Oceans, \*Coasts, \*Sediments, \*Erosion, \*Continental slope, \*Geomorphology, \*Marine geology, \*Eastern U.S., \*Depth zones, \*Water masses.

Areas measured between contours at 20-m intervals on most of the continental shelf off eastern North America were used to construct histograms and cumulative curves of areas of bottom and volumes of overlying water at various depths. The largest and deepest (212-m to 93-m median depths) shelf provinces are those that have undergone glacial erosion; these have most of the overlying water. More typical of continental shelves of the world are those floored by thick sediments; they have median depths between 27 and 40 m and most are broadly convex in profile between the shore and the shelf break. Also convex upward are the belt between the shore and the -100-m contours and the belt between -20 m and 20 m above sea level. However, the belt between the 20-m and 100-m contours and the broader one between the -100-m and 100-m contours are concave upward. This geometry is about what would be expected from the known history of marine erosion and deposition on a relatively submergent coast. (Sims-ISWS) W80-03367

#### TRACER STUDY OF SEDIMENT-WATER INTERACTIONS IN ESTUARIES, Rhode Island Univ., Kingston. Graduate School of Oceanography.

For primary bibliographic entry see Field 2J. W80-03368

#### FACTORS INFLUENCING WATER MOVEMENTS IN THE FIRTH OF CLYDE, Marine Lab., Aberdeen (Scotland). H. D. Dooley.

Estuarine and Coastal Marine Science, Vol 9, No 5, p 631-641, November 1979. 9 Fig, 1 Tab, 7 Ref.

Descriptors: \*Circulation, \*Currents(Water), \*Estuaries, \*Water circulation, \*Current meters, \*Measurement, \*Coasts, \*Tidal waters, \*Winds, \*Temperature, \*Water temperature, \*Salinity, \*Density, \*Transmissivity, \*Chlorophyll, \*Sampling, \*Oceanography, \*Scotland, \*Firth of Clyde(Scotland).

In the period 1972-1974, 530 days of current observations were obtained in the Firth of Clyde, on the west coast of Scotland. In addition, hydrographic surveys were conducted at frequent intervals from which geostrophic currents were calculated. Tidal streams in the area were low (less than 10 cm/s), and because of the resulting low levels of turbulence and mixing, the water structure was patchy with relatively large horizontal and vertical density gradients. Many of the fluctuations in velocity were due to advection of the patches which were

in geostrophic balance. In addition, there were wind-driven flows which occasionally caused rapid renewal of the water in the Firth of Clyde. The wind/current relationship was complex, however, and appeared dependent on the existing density distribution. (Sims-ISWS) W80-03369

#### MINOR ELEMENTS IN THE SEDIMENTS OF THE THAMES ESTUARY,

Thames Water Authority, London (England). Directorate of Scientific Services.

For primary bibliographic entry see Field 2J. W80-03370

#### PHYTOPLANKTON PRODUCTION IN A TURBID, TEMPERATE SALT MARSH ESTUARY,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.

R. E. Turner, S. W. Woo, and H. R. Jitts. Estuarine and Coastal Marine Science, Vol 9, No 5, p 603-613, November 1979. 5 Fig, 3 Tab, 33 Ref.

Descriptors: \*Phytoplankton, \*Estuaries, \*Salt marshes, \*Georgia, \*Plankton, \*Primary productivity, \*Aquatic productivity, \*Coasts, \*Tidal waters, \*Wetlands, \*Marshes, \*Sampling, \*Light, \*Temperature, \*Water temperature, \*Storms, \*Biology, \*Wassaw Sound(GA).

Maximum rates of particulate formation (P sub max) by phytoplankton in the Wassaw Sound estuary (Georgia, U.S.) average 20.2 mg C/cu m/h. Annual primary production is about 90 g C/sq m. The point at which plankton photosynthesis is saturated with light (I sub k) is lowest during winter. Short term temperature fluctuations cause a shift in I sub k paralleling the seasonal relationship of I sub k vs. temperature. Seasonal changes in P sub max are also closely related to temperature in the estuary. Temporal and spatial variation of both P sub max and light attenuation is considerable. The marsh appears to be a net consumer of photosynthetically active phytoplankton cells. Estuarine flushing by storms and rivers spills the accumulated estuarine phytoplankton into the nearshore zone where the much more favorable light conditions lead to a dramatic increase in production per sq m. (Sims-ISWS) W80-03372

#### A COMPARISON OF THE AXIAL DISTRIBUTIONS OF SALT AND 137CS IN THE SEVERN ESTUARY DURING AUGUST 1974,

Institute for Marine Environmental Research, Plymouth (England).

For primary bibliographic entry see Field 5B. W80-03373

#### SEASONAL SHIFTS OF SEDIMENT WITHIN AN ESTUARY MEDIATED BY ALGAL GROWTH,

Birkbeck Coll., London (England). Dept. of Geology.

For primary bibliographic entry see Field 2J. W80-03374

#### COASTAL COLLOIDAL CARBON: A STUDY OF ITS SEASONAL VARIATION AND THE POSSIBILITY OF RIVER INPUT,

Duke Univ., Beaufort, NC. Marine Lab.

A. Zsolnay. Estuarine and Coastal Marine Science, Vol 9, No 5, p 559-567, November 1979. 6 Fig, 3 Tab, 18 Ref. ONR N00014-78-C-0294.

Descriptors: \*Carbon, \*Colloids, \*Sea water, \*Atlantic Ocean, \*North Carolina, \*Coasts, \*Sampling, \*Monitoring, \*Organic matter, \*Rivers, \*Seasonal, \*Variability, \*Analytical techniques, \*Chromatography, \*Oceanography, \*Pyrolysis.

The concentration of organic colloidal and nonparticulate carbon was monitored for one year off the coast of North Carolina. The mean value for colloidal carbon was 143 ± 25.0 micrograms/liter. No seasonal pattern was apparent. Furthermore, the

amount of colloidal carbon appeared to be independent of the amount of nonparticulate carbon. On an average, 11 ± 2.0% of the nonparticulate carbon was colloidal. A strong negative correlation between colloidal carbon concentrations and salinity was found, indicating that the bulk of the colloidal material in rivers does not reach the coast. 'Fingerprints' obtained with pyrolysis-gas liquid chromatography show that coastal and river/estuarine colloidal material are composed of different compounds. Coastal colloidal material had no significant fluorescence or light absorption in the ultraviolet and visible range, indicating that it is poor in aromatics and other chromophores. Therefore, it is not composed of gelbstoff. (Sims-ISWS) W80-03375

#### COMMUNITY STRUCTURE AND SEASONAL VARIATION IN INTERTIDAL PANAMANIAN SANDY BEACHES,

San Diego State Univ., CA. Center for Marine Studies.

D. M. Dexter. Estuarine and Coastal Marine Science, Vol 9, No 5, p 543-558, November 1979. 5 Tab, 47 Ref.

Descriptors: \*Beaches, \*Biological communities, \*Benthic fauna, \*Pacific Ocean, \*Sampling, \*On-site investigations, \*Intertidal areas, \*Coasts, \*Tropical regions, \*Biomass, \*Density, \*Biology, \*Panama, \*Caribbean Sea.

Two Panamanian sandy beaches, one along each coast, were examined in 1973-1974 as a continuation of preliminary sampling in 1969-1970. Infaunal community structure for each beach was described in terms of species composition, density, biomass, diversity, and evenness. The influence of environmental factors on the zonation and abundance of the dominant species was discussed. The Caribbean beach was exposed to a marked wet vs. dry season, while the major environmental feature of the Pacific beach is a strong upwelling of cool water during the dry season. Community structure of the Caribbean beach was characterized by lower density, fewer species, higher diversity, and greater fluctuation among faunal dominants. The Pacific beach fauna had higher density, greater number of species, and lower diversity due to the dominance by the isopod *Excirolana braziliensis*. Explanations for the major differences in community structure between the two beaches were presented. (Sims-ISWS) W80-03376

#### THE DETERMINATION OF ESTUARINE SEDIMENTATION RATES BY 134CS/137CS AND OTHER ARTIFICIAL RADIONUCLIDE PROFILES,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.

For primary bibliographic entry see Field 2J. W80-03377

#### SALT MARSHES AND SALT DESERTS OF THE WORLD,

Auckland Univ. (New Zealand). Dept. of Botany. V. J. Chapman.

In: Ecology of Halophytes, Reimold, R. J., and Queen, W. H. (eds.), Academic Press, Inc., New York. p 3-19, 1974. 1 Fig, 112 Ref.

Descriptors: \*Salt marshes, \*Deserts, \*Geographical regions, \*Wetlands, \*Marshes, \*Marsh plants, \*Distribution patterns, \*Halophytes, \*Desert plants, \*Saline soils.

One characteristic of salt marshes and salt deserts is provided by the fact that only a relatively small number of plant species are capable of tolerating the degrees of salinity that occur. As a result, there are broad geographical areas in which there is a substantial uniformity in the vegetation. In some cases, subdivision can be based on temperatures or upon soil type. The dominant vegetation of maritime salt marshes is essentially phanerogamic herbs, though some shrubs also occur. Inland salt marshes, and especially salt deserts, are typified by shrubs. Apart from the phanerogams, maritime salt

## Field 2—WATER CYCLE

### Group 2L—Estuaries

marshes also carry an extensive algal vegetation which may, in places, be as important as the phanerogams. (Steiner-Mass)  
W80-03504

**PRODUCTION AND STRUCTURE IN THE EARLY STAGES OF VEGETATION DEVELOPMENT IN THE LAUWERSZEE-POLDER,** Groningen Rijksuniversiteit (Netherlands). Afdeling Plantenecologie.

W. Joenje.  
Vegetatio, Vol 29, No 2, p 101-108, November 25, 1974. 6 Fig, 4 Tab, 11 Ref.

Descriptors: \*Estuarine environment, \*Vegetation establishment, \*Halophytes, \*Succession, \*Productivity, \*Embankments, Mud flats, Wetlands, Ecological distribution, Saline soils, Salt tolerance, \*Netherlands.

During the first growing season after embankment of the Lauwerszee estuary, there was a rapid increase in biomass and appearance of many species on quickly desalinating areas, and a slow colonization by only a few species and low productivity on areas with impeded desalination. The halophytic pioneer vegetation consisted almost completely of *Salicornia* spp., *Suaeda maritima*, *Atriplex hastata*, and *Spartina x townsendii*. In the initial stage after embankment, plant densities were determined by the available amount of seeds, while after three years the total number and biomass was limited by environmental factors, especially those affecting soil fertility. The low productivity of the polder communities probably results from low fertility that limits the growth of the halophytes (which are used to a relatively rich supply of nutrients), and the salinity and delays in dispersal that exclude other species. (Howard-Mass)  
W80-03524

**TIDELANDS AND THE PUBLIC TRUST: AN APPLICATION FOR SOUTH CAROLINA,** For primary bibliographic entry see Field 6E.  
W80-03526

**EFFECTS OF OFF-ROAD VEHICLES ON THE SEDIMENTS OF HATCHES HARBOR, CAPE COD NATIONAL SEASHORE,** Massachusetts Univ., Amherst. Dept. of Geology.  
For primary bibliographic entry see Field 4C.  
W80-03535

**EFFECTS OF OFF-ROAD VEHICLES ON PLANTS OF A NORTHERN MARSH,** Massachusetts Univ., Amherst.  
For primary bibliographic entry see Field 4C.  
W80-03536

**HABITAT DEVELOPMENT FIELD INVESTIGATIONS, SALT POND NO. 3 MARSH DEVELOPMENT SITE, SOUTH SAN FRANCISCO BAY, CALIFORNIA; SUMMARY REPORT,** San Francisco Bay Marine Research Center, Inc., Richmond, CA.  
For primary bibliographic entry see Field 4A.  
W80-03555

**NUMERICAL SIMULATION OF THE COOS BAY-SOUTH SLOUGH COMPLEX,** Army Engineer Waterways Experiment Station, Vicksburg, MS.  
H. L. Butler.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A063 698. Price codes: A07 in paper copy, A01 in microfiche. Technical Report H-78-22, December 1978. 123 p, 1 Tab, 8 Ref, 1 Append, 90 Pl.

Descriptors: \*Estuaries, \*Bays, \*Inlets (Waterways), \*Mathematical models, Simulation analysis, \*Numerical simulation, \*Tidal inlets, \*Coos Bay (Ore).

Coos Bay Inlet, on the south central coast of Oregon, provides tidal flow to two estuary systems: Coos River to the north and South Slough to

the south. Charleston Harbor is located at the entrance into South Slough and is affected by continual shoaling problems within the harbor entrance channel. A two-dimensional numerical tidal model (WIFM) was used to investigate the tidal hydrodynamics of the inlet complex. The complex geometry of the Coos Bay area made it necessary to develop a capability of computing the tidal regime on a variable grid system. This study applies WIFM to the Coos Bay-South Slough complex to predict quantitatively the hydrodynamics (exclusive of sediment transport and wave action) of the tidal flow in the system and compare existing conditions and alternate improvement plans. The improvement plans provide for: 1. Construction of specified navigation channels; 2. Alternate breakwater extensions west of the entrance channel; 3. Alternate detached groins east of the entrance channel. Five alternate plans were tested, and the results show that the introduction of any of the improvement plans as proposed would not produce any detrimental impact to tidal circulation in South Slough. (WES)  
W80-03559

**MOVEMENT OF SUSPENDED PARTICLES AND SOLUTE CONCENTRATIONS WITH INFLOW AND TIDAL ACTION,** Army Engineer Waterways Experiment Station, Vicksburg, MS.  
A. N. Williamson.  
Available from the National Technical Information Service, Springfield, VA 22161 as N73-25358. Price codes: A02 in paper copy, A01 in microfiche. Technical Report M-78-2, August 1978. 170 p, 19 Fig, 6 Tab, 16 Ref, 3 Append.

Descriptors: \*Suspended load, \*Solute, \*Data collections, \*Inflow, Tides, Chesapeake Bay, Movement, Suspended solids, Tidal effects, Salinity, \*Spectrum analysis.

Landsat (formerly called ERTS-1) data recorded on computer-compatible tapes (CCT's) augmented by data derived from ground control measurements were used to determine the feasibility of detecting alterations to the optical properties of water caused by the movement of suspended particles and solutes in selected portions of the Chesapeake Bay area. Techniques were developed to process CCT's on a PDP-15 computer, establish correlations of radiance and suspended material concentrations, and produce suspended material distribution photomaps. This report discusses these techniques, and includes in appendices a discussion of experience with automated data collection systems in connection with this study, validation of the computer algorithms for high suspended material concentrations, and by-products that resulted from this study. (WES)  
W80-03564

### 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

#### 3A. Saline Water Conversion

**PROCESS DESIGN OF A 100,000 GALLON PER DAY VACUUM FREEZING EJECTOR ABSORPTION PILOT PLANT,** Chicago Bridge and Iron Co., Plainfield, IL.  
V. F. Allo, T. R. Carbery, D. C. Cutler, G. E. Engdahl, and J. A. Nail.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-144017. Price codes: A07 in paper copy, A01 in microfiche. Final Report to Office of Water Research and Technology, December 1979. 111 p. Append, OWRT C-90058-D (9512) (1), 14-34-0001-9512.

Descriptors: \*Desalination, \*Desalination freezing process, Vacuum freezing, Ejector, Absorption, Design, Concept, Pilot plants, Cost analysis, Water desalting, Crystallization, Freezing.

A conceptual design study of the vacuum freezing ejector absorption (VFEA) process was completed and specifications were prepared for a nominal

100,000 gallon per day pilot plant. Included in the design are a process flow sheet, piping and instrumentation diagrams, equipment specifications, a computer program model, and preliminary engineering drawings. VFEA is a freeze desalination process in which water vapor from a vacuum freezer is compressed by a combination steam ejector and absorber loop. The absorption solution for this design is concentrated sodium hydroxide. Also included is an estimated budget cost to do the final engineering and to build the pilot plant.  
W80-03301

**DESALINIZATION AND CHEMICAL EXTRACTION PROCESS,** Desal-Chem, Inc., Tulsa, OK. (Assignee).  
D. D. Childress.

U.S. Patent No 4,176,023, 6 p, 3 Fig, 1 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1038, November 27, 1979.

Descriptors: \*Patents, \*Desalination, \*Water purification, \*Desalination processes, Water treatment, Desalination apparatus, Vapor compression distillation, Separation techniques, Waste, Electrolysis, Gases, Chlorine, By-products.

A combined desalination and extraction process is described for brinewater having a salinity of 7 1/2% to 9%. The brinewater is introduced to a concentrator basically similar to a shell-and-tube type heat exchanger vertically arranged with upper and lower chambers above and below the tube section and communicating with each other through the tubes. A heating element in the lower chamber causes the brinewater to be heated until it reaches its boiling temperature. Vapors are removed from the upper chamber and are externally compressed so as to create a partial vacuum in the upper chamber. The compressed vapors are passed from the compressor to the concentrator into the spaces on the outside of the tubes where the vapors are condensed as liquid water. The condensed fresh water on the outside of the tubes is removed. The remaining brinewater within the tubes, which is concentrated at 28% salinity, is conducted to electrolytic cells having positively charged anodes and negatively charged cathodes. The concentrated brine is electrolyzed with low voltage direct current to release chlorine gas, caustic alkali containing primarily sodium hydroxide, hydrogen gas, and an inert material containing calcium, nitrogen, and magnesium oxide. The chlorine gas is conducted to a mist extractor separator to remove any impurities and then compressed to form liquid chlorine. The hydrogen gas is conducted to a mist extraction separator to remove any impurities. (Sinha-OEIS)  
W80-03464

**SOCIO-ECONOMIC CHANGES AND DEVELOPMENT OF WATER RESOURCES IN SAUDI ARABIA,** King Abdulaziz Univ. Jeddah (Saudi Arabia). Dept. of Biology.  
For primary bibliographic entry see Field 6D.  
W80-03502

**THE ECONOMIC FEASIBILITY OF DUAL PURPOSE NUCLEAR DESALINATION OF GROUND WATER,** New Mexico State Univ., Las Cruces. Dept. of Agricultural Economics.  
R. R. Lansford, S. Ben-David, F. Roach, B. J. Creel, and T. H. Stevens.  
Water Resources Bulletin, Vol 15, No 6, p 1589-1601, December, 1979. 2 Fig, 6 Tab, 11 Ref.

Descriptors: \*Southwest U.S., \*Desalination plants, \*Economic feasibility, \*Nuclear powerplants, Ground water, Brackish water, Freshwater, Heat transfer, Flash distillation, Reservoirs, Irrigation, Recreation, Brine disposal, Byproducts, Water transfer.

The economic feasibility of using a nuclear power facility for simultaneous energy production and desalination of brackish ground water was evaluated for the Southwestern United States. Other benefits to be derived from such a dual purpose facility

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Conservation In Agriculture—Group 3F

are mineral recovery using heat which is usually wasted in power production, water-based recreational opportunities, and irrigation storage. Two alternative project designs were developed. The first alternative considered all the possible project benefits mentioned above while the second alternative included transferring desalted water to two adjacent rivers instead of a reservoir. In the first alternative, the net benefits ranged from \$-986.57 million at a 5% discount rate to \$-1,137.528 million at a 10% discount rate. In the second alternative, net benefits ranged from \$-382.527 million to \$-478.612 million at the 5 and 10 percent discount rates. With the possible introduction of hot, dry rock geothermal energy, the cost of desalination may be reduced enough to make dual purpose nuclear desalination of ground water in the southwest economically feasible. (Purdin-NWWA) W80-03544

### 3B. Water Yield Improvement

#### SOCIO-ECONOMIC CHANGES AND DEVELOPMENT OF WATER RESOURCES IN SAUDI ARABIA

King Abdulaziz Univ. Jeddah (Saudi Arabia). Dept. of Biology.  
For primary bibliographic entry see Field 6D. W80-03502

#### THE ECONOMIC FEASIBILITY OF DUAL PURPOSE NUCLEAR DESALINATION OF GROUND WATER

New Mexico State Univ., Las Cruces. Dept. of Agricultural Economics.  
For primary bibliographic entry see Field 3A. W80-03544

#### PERFORMANCE EVALUATION OF WATER HARVESTING CATCHMENTS

Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.  
G. W. Frasier, K. R. Cooley, and J. R. Griggs.  
Journal of Range Management, Vol 32, No 6, p 453-456, Nov 1979. 2 Fig, 3 Tab, 4 Ref.

Descriptors: \*Water harvesting, \*Rainfall-runoff relationships, \*Sprinkling, \*Membranes, \*Water yield improvement, Evaluation, Surface sealing, Infiltration, Surface runoff, Testing procedures.

A small portable sprinkler was used to estimate runoff efficiencies of various catchment treatments on 14 operational water harvesting systems at the Granite Reef Test Site in Arizona. This method, which is verified using actual rainfall-runoff data from test plots, indicates that the performance of a water harvesting system depends on the effectiveness of the catchment apron treatment to inhibit infiltration. Membrane treatments, like asphalt, fiberglass, and butyl, yielded 90-100% precipitation runoff while properly installed wax-type treatments yielded over 80% runoff. A gravel-covered polyethylene treatment was found to require a high threshold rainfall quantity to overcome water retention within the gravel layer. It is hoped that this sprinkler method will permit evaluation of catchment runoff efficiencies without resorting to the time and effort required for large field-instrumentation projects. (Tickes-Arizona) W80-03552

### 3C. Use Of Water Of Impaired Quality

#### WELL DRILLING FOR +250F WATER

Oregon Inst. of Tech., Klamath Falls. Geo-Heat Utilization Center.  
For primary bibliographic entry see Field 8A. W80-03428

WASTEWATER HELPS THE BARLEY GROW, Arizona Univ., Tucson. Dept. of Plant Sciences. D. A. Day, J. A. McFadyen, T. C. Tucker, and C. B. Cluff.

Water and Wastes Engineering, Vol 16, No 8, p 26-28, August 1979. 4 Tab.

Descriptors: \*Barley, \*Water reuse, \*Irrigation effects, \*Crop response, Waste water disposal, Municipal wastes, Environmental effects, Plant growth, Soil properties, Hydrogen ion concentration, Mixing.

The effects of treated municipal wastewater on crops, soils, and irrigation water were investigated in this study near Buckeye, Arizona, 1974-75, to compare (1) response of barley irrigated with a mixture of pump water and wastewater with the response to pump water alone, (2) the effect of pump water and pump water-wastewater irrigation on soil properties, and (3) quality of a pump water-wastewater mixture with that of pump water alone as a source of irrigation water for barley production. Effects of the two treatments were studied on 'Arivat' barley fields set in a modified randomized complete block experimental design with four replications in a predominantly coarse loam soil. Results indicate that barley grown with the mixture was superior in growth, grain yield and quality to that irrigated with pump water alone, while the soil under both types of irrigation had similar pH at the end of the study. Conclusions indicated that treated municipal wastewater can be used as a partial source of irrigation water and plant nutrients in the commercial production of barley in the irrigated areas of the arid southwest U.S. as well as in other similar climatic regions throughout the world. (Tickes-Arizona) W80-03547

### 3E. Conservation In Industry

#### PROCESS FOR THE SEPARATION OF FOAM FROM EFFLUENTS OF COKE OVEN PLANTS, United States Steel Corp., Pittsburgh, PA. (Assignee).

L. K. Husher, H. Weber, and K. Tippmer.  
US Patent No 4,176,062, 6 p, 2 Fig, 1 Tab, 9 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1050-1051, November 27, 1979.

Descriptors: \*Patents, \*Separation techniques, \*Foam separation, Industrial wastes, Recycling, Water reuse, Coals, Coke oven plants, Tars.

A process is provided for the separation of suspensions and foam from the tar, ammonia liquor and condensate mixture obtained when coking finely ground pre-dried or reheated coal without considerable additional expenditures and consumption of energy and chemicals. A tap phase and a liquid phase are obtained so that the liquid phase can be recycled to the collection main and can be used, problem-free for the cooling of the hot gases produced when coking the coal and surplus liquor can be further processed. The mixture consisting of tar, ammonia liquor and condensate is freed from coarse particles in a primary decanter with concomitant development of a surface suspension and foam of 'swimming tar'. The suspension and foam floating on the surface of the ammonia liquor in the primary decanter is removed by traveling mechanical skimmers, delivered to a foam separator, and permitted to reside in the foam separator for at least two hours to effect separation of a water phase. The water phase is removed from the foam separator and recycled to the primary decanter. (Sinha-OEIS) W80-03331

#### ANTI-CORROSION COMPOSITION FOR USE IN AQUEOUS SYSTEMS, Quatic Chemicals Ltd., Guelph (Ontario). (Assignee).

For primary bibliographic entry see Field 5G. W80-03409

#### INDUSTRIAL WATER ALLOCATION AND CONSERVATION IN CALIFORNIA

California State Dept. of Water Resources, Sacramento. Office of Emergency Services.  
A Compendium of Information for Industrial Water Managers Compiled from Proceedings of

the Drought Conference on Industrial Water Allocation and Conservation, January 1978. 148 p.

Descriptors: \*California, \*Industrial water, \*Water allocation(Policy), \*Water demand, \*Water conservation, Droughts, Industry, Water resources, Water supply, Water consumption, Water policy, Water utilization, Conservation, Water, Water distribution, Planning.

This is a compilation of proceedings of the Drought Conference on Industrial Water Allocation and Conservation held in Concord and Los Angeles (CA) during July 1977. Industrial water use is California's third and smallest sector of water use but the problem of water conservation was recognized even prior to the drought which California was experiencing at the time of this conference. Industry has the best record in conservation as compared to other water use sectors. In California 56% of the industrial water use comes from purveyors (water agencies) and about 44% is self-produced; this includes well water and water taken from rivers. Some short-range plans for industrial conservation include: (1) electrostatic water treatment for cooling towers; (2) re-use of overflow water; (3) recycled water from conductivity transducers; (4) used spray booth recycled water for bearing water makeup at sludge farm pumps; (5) outside water test controls; (6) time rinse sections of washers; and (7) automatic blow down controls for boilers. The potential savings for each of these plans range from 3,500 gallons per day to 46,000 gallons per day. Long-range water conservation plans include the recycling of car wash water and recycling water for wet sand facilities. The report includes discussions of the statewide response to the 1976-1977 drought, future water supplies and the third year of the drought, industrial water supplies for northern and southern California, local agency responses to the drought, specific industrial conservation programs and techniques, and methods of financing water conservation. (Iervolino-NC) W80-03597

### 3F. Conservation In Agriculture

#### PHREATOPHYTE EVAPOTRANSPIRATION AND ITS POTENTIAL REDUCTION WITHOUT ERADICATION

California Univ., Davis. Dept. of Land, Air and Water Resources.  
For primary bibliographic entry see Field 2D. W80-03442

USE OF ENVIRONMENTAL DATA IN ASSESSING THE QUALITY OF IRRIGATION WATER, Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.  
For primary bibliographic entry see Field 5G. W80-03471

#### DEVICE FOR AUTOMATIC, SELECTIVE WATERING OF PLANTS

L. Richard.  
U.S. Patent No 4,175,579, 7 p, 4 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 890, November 27, 1979.

Descriptors: \*Patents, \*Irrigation, \*Irrigation systems, Water distribution(Applied), Irrigation practices, Irrigation efficiency.

A device for automatically selectively watering plants in a predetermined order for predetermined times comprises a casing which is connected to a source of water under pressure. The device houses a turbine wheel arranged to be driven by the water and to drive a set of gears which form a speed reducer, the output shaft of which extends out of the casing and carries a number of cams spaced apart along the shaft and each arranged to operate a valve of the pilot-operated type. The valves are identical, juxtaposed in a straight line, and connected to pipes provided with watering nozzles. (Sinha-OEIS) W80-03506

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3F—Conservation In Agriculture

#### TRICKLE IRRIGATION TIMING AND ITS EFFECT ON PLANT AND SOIL WATER STATUS

Ben Gurion Univ. of the Negev, Beersheba (Israel). Inst. of Desert Research. J. Ben-Asher.

Agricultural Water Management, Vol 2, No 3, p 225-232, Nov 1979. 3 Fig, 4 Tab, 3 Ref.

Descriptors: \*Timing, \*Irrigation efficiency, \*Water balance, \*Percolation, \*Trickle irrigation, Irrigation practices, Crop response, Dune sands, Soil-water-plant relationships.

The effect of trickle irrigation timing was tested with tomato plants on Sinai sand dunes to estimate the various components of water balance under different high-frequency irrigation regimes, and to propose recommendations for irrigation policy. Irrigations were applied during daytime hours for one field and a short time after sunset on a second field in the uniform coarse sandy soil on a coastal area of Nahal Sinai. Results indicate that daytime irrigation of soil with low water-holding capacity significantly increased yields, improved plant water potential, and improved water use efficiency. The author concludes that controlling deep percolation, the dominant component of the water balance under these conditions, requires the measurement of net radiation flux as input for managing the quantity of water to be applied. (Tickes-Arizona) W80-03545

#### IRRIGATION MACHINE,

J. M. Arlemark.

U.S. Patent No 4,174,809, 14 p, 10 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 988, No 3, p 625, November 20, 1979.

Descriptors: \*Patents, \*Irrigation, \*Application equipment, Sprinkler irrigation, Irrigation practices, Irrigation efficiency, Irrigation operation and maintenance.

The invention relates to an irrigation machine with a hose reel, rotatably mounted on a wheeled frame for a withdrawable and rewindable hose. One end, fixed to the hose reel, is connectable via a coupling to a water supply source and the other end is connected to a sprinkler gun on a gun carriage or sled. The reel for the hose, which is compression resistant and consists of rigid hose material, is coupled to a driving motor designed as a water turbine. The motor is coupled into a conduit system from the water supply source to the sprinkler gun and the hose reel is mounted with its axis of rotation substantially horizontal. The water turbine is coupled into the conduit system via an adjustable flow divider in the form of a three-way valve with one inlet and two outlets, the water turbine being connected in between the two outlets. (Sinha-OEIS) W80-03584

#### IRRIGATION SYSTEM,

Hitachi Chemical Co. Ltd., Tokyo (Japan). (As-signee).

S. Watanabe, and M. Metsugi. U.S. Patent No 4,174,067, 4 p, 2 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 988, No 2, p 365, November 13, 1979.

Descriptors: \*Patents, \*Irrigation, \*Irrigation systems, \*Application equipment, Irrigation practices, Irrigation efficiency, Irrigation operation and maintenance, Drip irrigation, Compressed air.

An irrigation system comprises a source of pressurized water and passages for conducting the water from the source to individual irrigation spots. The passages include a plastic pipe having very small slip openings for continuously discharging water. A source of compressed air is connected to the passages and an operational control temporarily stops the supply of pressurized water while the compressed air is discharged through the small slip openings to clear them from clogging. (Sinha-OEIS) W80-03595

#### 4. WATER QUANTITY MANAGEMENT AND CONTROL

##### 4A. Control Of Water On The Surface

LAND-USE AND UPLAND WATER RESOURCES IN BRITAIN—A STRATEGIC LOOK, Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2A. W80-03363

PERSPECTIVES FROM THREE YEARS EXPERIENCE OF REGIONAL WATER SERVICES IN THAMES WATER AUTHORITY, Thames Water Authority, London (England). For primary bibliographic entry see Field 5G. W80-03364

##### SUMMARY REPORT, SOUTHEAST CONFERENCE ON URBAN STORMWATER MANAGEMENT,

North Carolina Water Resources Inst., Raleigh. D. H. Howells.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-147564, Price codes: A05 in paper copy, A01 in microfiche. SE Water Resources, Vol 2, No 1, Fall 1979. Conference held April 10-11, 1979 at NC State U, Raleigh. 80 p, 35 Fig. Water Resources Research Institute, University of North Carolina. OWRP B-123-NC(5), 14-34-0001-9144.

Descriptors: \*Storm water, \*Storm runoff, \*Urban runoff, Drainage programs, Water policy, Storage, Flood plain zoning, Flood plains, Erosion control, Sediment control, Water pollution control, Conferences, Southeast U.S., Government, Local governments, State governments.

State, local, and regional programs for urban stormwater management (SWM) in the southeastern U.S. are discussed. Drainage and detention, flood plain management, erosion and sedimentation control, and stormwater pollution control tend to be dealt with in each geographical area on an individual basis. Community implementation of a unified SWM program covering the four areas integrated with zoning and subdivision ordinances is suggested. Prototype water quality studies, urban drainage programs and ordinances, national policy, and conclusions and recommendations of the conference participants are presented. It is recommended that ordinances in general should be concerned with policy and budgetary matters, not engineering criteria, design standards, or administrative detail. More involvement of interest groups, public works agencies, and the public, greater information/technology diffusion, more commitment of state governments, and more local monitoring of programs are suggested. (Schaefer-IPA) W80-03381

##### THE APPLICATION OF HYDROLOGIC MODELS TO SMALL WATERSHEDS HAVING MILD TOPOGRAPHY,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2B. W80-03469

##### THE IMMEDIATE EFFECTS OF DITCHING A SALTMARSH ON NESTING HERRING GULLS LARUS ARGENTATUS,

Livingston Coll., New Brunswick, NJ. Dept. of Biology.

J. Burger, and J. K. Shisler. Biological Conservation, Vol 15, No 2, p 85-103, February, 1979. 8 Fig, 1 Tab, 53 Ref.

Descriptors: \*Saltmarshes, \*Gulls, \*Nesting, \*Ditches, \*Drainage effects, Animal behavior, Birds, Life history studies, Habitat, Nesting cover, Marshes, Wetlands, Environmental effects, Breeding.

The number of pairs of herring gulls breeding on an island in Barnegat Bay, New Jersey, remained the same as in the previous year after ditching in March, before the start of the breeding season. The number of breeding pairs on two nearby islands which were not ditched increased by 46% and 90%. Breeding chronology was similar on all three areas, but birds nesting on spoil laid eggs a mean of 8 days later than non-spoil nesting birds. Behavioural observations on aggression and display rates indicated that birds on spoil behaved similarly to those in open grassy areas but differed from those nesting in the bushes. Nest site selection, breeding densities, and breeding success were similar on all three islands. The differences noted were attributed to the appearance of the marsh. It was postulated that pairs having nested on the experimental island in the previous year continued to nest after the island was ditched and pairs searching for new territory colonized the nearby islands. The later nesting of pairs breeding on spoil is attributed to the need to defend their nest sites which were situated in areas used for display by unmated birds. (Howard-Mass) W80-03520

##### HABITAT DEVELOPMENT FIELD INVESTIGATIONS, SALT POND NO. 3 MARSH DEVELOPMENT SITE, SOUTH SAN FRANCISCO BAY, CALIFORNIA; SUMMARY REPORT,

San Francisco Bay Marine Research Center, Inc., Richmond, CA.

J. H. Morris, C. L. Newcombe, R. T. Huffman,

and J. S. Wilson.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A065 775, Price codes: A03 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Miss. Technical Report D-78-57, December 1978. 22 p, 3 Tab.

Descriptors: \*Salt marshes, \*Habitats, \*Marsh plants, Planting management, Plant growth, Dredged material, Habitat development, Marsh development, \*San Francisco Bay(Calif.), Spartina foliosa.

A study of marsh development on confined dredged material substrate in an abandoned salt pond in South San Francisco Bay demonstrated that a California cordgrass (*Spartina foliosa*) marsh can be established within 2 years. For successful marsh development, proper elevations and tidal flow must be provided. For the San Francisco Bay area, sprigs should be planted in early spring on low wave energy sites and at 0.5- to 1.0-m intervals within the lower two-thirds of the intertidal range. (WES) W80-03555

##### MAXIMUM UTILIZATION OF WATER RESOURCES IN A PLANNED COMMUNITY -- APPLICATION OF THE STORM WATER MANAGEMENT MODEL, VOLUME I,

Espey, Huston and Associates, Inc., Austin, TX. E. V. Diniz, and W. H. Espey.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-121437, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Technology Series Report No EPA-600/2-79-050C, July 1979. 181 p, 68 Fig, 42 Tab, 23 Ref, 5 Append. 802433.

Descriptors: \*Mathematical models, \*Runoff forecasting, \*Urban runoff, \*Texas, \*Drainage systems, Watersheds(Basins), Hydrographs, Base flow, Infiltration, Rainfall-runoff relationships, Surface runoff, Paving, Water quality, Land use, Water pollution, Erosion.

The Storm Water Management Model (SWMM) was extensively modified and used to model runoff and water quality from natural drainage areas in the Woodlands, an ecologically planned community in Texas, and in the Hunting Bayou, an urbanized watershed near Houston, Texas. New subroutines were programmed to allow SWMM to model (1) separate sewer systems, (2) urbanization effects on baseflows, (3) performance and cost efficiency of natural drainage systems, (4) additional water quality parameters (chemical oxygen demand,

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Effects On Water Of Man's Non-Water Activities—Group 4C

Kjeldahl nitrogen, nitrates, and phosphates), and (5) hydrologic effects of porous pavements. These additional user options provide more model versatility such as the modelling of storm periods separated by low or zero rainfall and the computation of baseflow recessions. Using the model hydrographs were developed for 14 storms at the study sites. Overall results show that SWMM can be a successful tool for the prediction of future urbanization effects, however, the model should be tested in other geographical areas and further developed or refined as additional data is collected. Model limitations are cited for areas with transient land use and areas where extremely high suspended solids concentrations are generated. New sub-routine source code listings and revised input coding instructions are included. (Seigler-IPA) W80-03565

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XIV-APPENDIX M, FLOOD CONTROL.**  
Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 2E.  
W80-03569

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME V-APPENDIX D, WATER SUPPLY AND WATER POLLUTION CONTROL.**  
Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 5G.  
W80-03577

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME IV-APPENDIX C, HYDROLOGY.**  
Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 2E.  
W80-03578

**THE DEVELOPMENT AND SERVICING OF SPATIAL DATA MANAGEMENT TECHNIQUES IN THE CORPS OF ENGINEERS,**  
Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch.  
For primary bibliographic entry see Field 6A.  
W80-03588

**FLOOD DAMAGE ASSESSMENTS USING SPATIAL DATA MANAGEMENT TECHNIQUES,**  
Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch.  
For primary bibliographic entry see Field 6A.  
W80-03589

**SPATIAL DATA ANALYSIS OF NONSTRUCTURAL MEASURES,**  
Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch.  
For primary bibliographic entry see Field 6A.  
W80-03590

#### 4B. Groundwater Management

**SOUTH DAKOTA GROUND WATER AND THE ARTESIAN PRESSURE: IS THE USE OF WATER FOR DOMESTIC PURPOSES STILL THE HIGHEST USE.,**  
For primary bibliographic entry see Field 6E.  
W80-03420

**THE MANAGEMENT OF GROUND WATER SUPPLIES,**  
Ground Water Consultants Group, Edmonton (Alberta).  
P. L. Hall.  
Water & Sewage Works, Vol 125, No 10, p 54-55, October, 1978. 1 Fig.

Descriptors: \*Water management (Applied), \*Ground water resources, \*Water supply, Aquifers, Water demand, Optimization, Planning,

Computer models, Water wells, Well spacing, Efficiencies, Conjunctive use, Artificial recharge, Environmental effects, Pumping, Storage.

The objectives of ground water management are: (1) to meet water demands; (2) to optimize water resources and existing distribution systems; and (3) to develop long-range plans. The physical limitations of the aquifer must be accurately determined before a management plan can be formulated. Peak demands can be met by storage facilities or increased withdrawals. Many water-well fields and their associated storage-distribution systems are not working at maximum efficiency due to interference between closely-spaced wells, scaling of well screens, and corrosion. Evaluation of well-field performance is complex and requires analog or digital computer models. The main advantage of using models is that alternative well locations and pumping rates and schedules can be compared in a short time without the need for expensive, prolonged field tests. The results of modeling are only as good as the quality of the input data. The data should be set up under the supervision of an experienced hydrologist. Long range planning should consider the finite capacity of the aquifer, future demands, adverse environmental impacts, conjunctive use, and artificial recharge. (Purdin-NWWA) W80-03435

**ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN CARSON COUNTY, TEXAS, PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,**  
Texas Dept. of Water Resources, Austin.  
For primary bibliographic entry see Field 7C.  
W80-03451

#### 4C. Effects On Water Of Man's Non-Water Activities

**TESTING OF SEVERAL RUNOFF MODELS ON AN URBAN WATERSHED,**  
Hydrologic Engineering Center, Davis, CA.  
For primary bibliographic entry see Field 2A.  
W80-03352

**DEALING WITH SITE DISTURBANCES FROM HARVESTING AND SITE PREPARATION IN THE LOWER COASTAL PLAIN,**  
Southern Forest Experiment Station, Pineville, IA. Forest Insect Research.  
E. Shoulders, and T. A. Terry.  
In: Proceedings, Symposium on Principles of Maintaining Productivity on Prepared Sites, Mississippi State University, March 21-22, 1978, Sponsored by US Forest Service and Southern Region of the Association of State College and University Forest Res. Organizations, p 85-97, 1978. 44 Ref.

Descriptors: \*Lumbering, \*Forest management, \*Coastal plains, Wetlands, Forests, Roads, Forestry, Soil water, Soil compaction, Soil management, Microenvironment.

Harvesting operations that are carried out when the soil is wet can seriously damage lower coastal plain sites by compacting, puddling, churning, and rutting the soil and by disrupting natural drainage so that excess water is trapped on the surface. Site productivity is substantially reduced unless measures are taken to repair the damage. Damage can be avoided by scheduling operations when the soil is strong enough to support the logging equipment. Preharvest site drainage lengthens the period when damage-free logging can be done. Confirming traffic to as few trails as possible limits the extent of the damage from wet weather logging. (Steiner-Mass) W80-03503

**DRAINAGE AND LARVICIDING FOR CONTROL OF A MALARIA FOCUS IN HAITI,**  
World Health Organization, Washington, DC. Malaria Eradication Dept.

D. J. Schliessmann, V. R. Joseph, M. Solis, and G. T. Carmichael.  
Mosquito News, Vol 33, No 3, p 371-378, September, 1973. 3 Fig, 3 Tab.

Descriptors: \*Salt marshes, \*Mosquitoes, \*Larvicides, \*Public health, Construction, Drainage effects, Environmental effects, Wetlands, Habitat, Human diseases, Carriers, \*Haiti.

Three outbreak of *P. falciparum* malaria with more than 1,500 cases were experienced by the Haiti malaria eradication program in a densely populated focus of 10,000 people in 27 months. The focus contributed more than 15 percent of the total cases reported in the country in contrast to less than 0.13 percent in similar time periods before and after the outbreaks. The outbreaks resulted from environmental and ecological changes brought about by the construction of a road and resettlement housing which obstructed the natural drainage of the salt marsh area and created extensive mosquito breeding habitats. It is likely that natural reductions in vector populations during the dry season contributed to limiting the duration of the three epidemics and probably accounts for the control of the first outbreak. Larviciding contributed to the control of the second epidemic. The third epidemic followed the suspension of larviciding which permitted a buildup of vector densities. Its control, and the prevention of malaria during 27 months following the outbreaks while malaria transmission in the country was increasing, is attributed to the combined effects of the drainage project and of the program of larviciding. (Howard-Mass) W80-03505

**IMPACTS OF COAL-FIRED POWER PLANTS ON FISH, WILDLIFE AND THEIR HABITATS,**  
Argonne National Lab., IL. Environmental Impact Studies.  
A. J. Dvorak, B. G. Lewis, P. C. Chee, E. H. Dettmann, and R. F. Freeman, III.  
U.S. Fish and Wildlife Service, Office of Biological Sciences Report FWS/OBS-78/29. March, 1978. 260 p, 29 Fig, 62 Tab, 371 Ref, 7 Append.

Descriptors: \*Powerplants, \*Coal, \*Water pollution effects, Power operation and maintenance, Environmental effects, Wildlife habitat, Aquatic habitat, Acid mine water, Chemical wastes, Air pollution, Water pollution, Pollution abatement, Pollutants.

This report contains an assessment of expected impacts to terrestrial and aquatic biota and their habitats which are associated with the operation of coal-fired power stations, from the point at which coal is delivered to the site through disposal of process wastes. Emphasis is placed on discussion of impacts unique to coal combustion, although some features of gas- and oil-fired stations are also addressed. Impacts arising from thermal effluents, condenser cooling facilities, and power transmission are not discussed. Mitigative measures to reduce the magnitude of some of these adverse impacts are described, and include pollution abatement devices, erosion control proper siting and lining of ash and sludge disposal ponds, and reclamation of inactive waste-disposal sites. Included in the report is a list of research topics suggested to improve impact assessment capabilities. (Steiner-Mass) W80-03518

**EFFECTS OF OFF-ROAD VEHICLES ON THE SEDIMENTS OF HATCHES HARBOR, CAPE COD NATIONAL SEASHORE,**  
Massachusetts Univ., Amherst. Dept. of Geology. J. A. Hamilton.  
Massachusetts University, National Park Service Cooperative Research Unit Report No 30, 1978. 23 p, 21 Fig, 1 Tab, 27 Ref.

Descriptors: \*Off-road vehicles, \*Sediments, \*Intertidal areas, \*Geomorphology, Wetlands, Tidal marshes, Sediment transport, Sedimentation, Massachusetts, Sands, Marshes.

Vehicles (ORVs) can greatly increase the amount of overwash by destroying the developing dune

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4C—Effects On Water Of Man's Non-Water Activities

vegetation on the protective sand spit. These overwash deposits are reworked by the daily tidal flooding in the inlet throat. Areas of exposed sand are subject to sediment transport by tidal action. ORV traffic can increase the amount of open sandy areas and rate of movement, and hence quicken the infilling of Hatches Harbor, by creating new sand channels through marsh areas. Because salt marsh vegetation enhances sedimentation by slowing down water flow, ORV disruption of these grasses would tend to thwart siltation. The net impact of ORV disturbance of salt marsh vegetation through the creation of open sandy areas would still be to increase the infilling of Hatches Harbor because of the large flood dominance of sediment transport. Other effects of ORV traffic on the exposed sand area vary with sand composition and vehicle usage. Vehicle passage disturbs the sediment packing to a depth of a few centimeters, which makes the material in disturbed areas more susceptible to transport by tidal currents than undisturbed surfaces. (Steiner-Mass) W80-03535

**EFFECTS OF OFF-ROAD VEHICLES ON PLANTS OF A NORTHERN MARSH,**  
Massachusetts Univ., Amherst.  
J. M. B. Brodhead, and P. J. Godfrey.  
Report No 33, 1979. 65 p, 35 Fig, 2 Tab, 16 Ref.

Descriptors: \*Marsh plants, \*Off-road vehicles, \*Vegetation regrowth, Wetlands, Marshes, Salt marshes, Marsh management, Peat, Massachusetts.

The impact of off-road vehicles (ORVs) on the marsh and tidal sand flat environment was determined through controlled impacts of undisturbed sites and the enclosure of ORVs on disturbed sites. Results show that ORV traffic in the low marsh completely destroys both vegetation and peat substrate and produces conditions that delay the rate of natural recovery as well as creates conditions that favor mosquito production. Traffic around the periphery of the marsh creates an ever-growing barren zone with erosion of adjacent dunes and continual degradation of both marsh and dune systems alike. Only a few passes of an ORV are sufficient to severely damage salt marsh species. Recovery, however, begins soon after protection from impacts. Plants found along the dune/marsh border, *Ammophila* and *Spartina patens* (erect), can recover in about two years. Full colonization of a barren flat can occur in two years. *Spartina alterniflora* begins invading disturbed peat substrate slowly but will develop nearly complete cover in four years. *Spartina patens* (decumbent) is the slowest marsh plant to recover following complete destruction. (Steiner-Mass) W80-03536

### 4D. Watershed Protection

**COMBINED VEGETATIVE-STRUCTURAL SLOPE STABILIZATION,**  
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.  
D. H. Gray, A. T. Leiser, and C. A. White.  
Civil Engineering-ASCE, Vol 50, No 1, p 82-85, January 1980. 3 Fig, 2 Tab, 7 Ref, 4 Photo.

Descriptors: \*Slope stabilization, \*Vegetation establishment, \*Erosion control, \*California, Bank stabilization, Methodology, Vegetation, Costs, Bank protection, Slope protection, Soils, Embankments, Wattling.

Vegetation in partnership with structural measures provides an attractive and cost effective method of stabilizing slopes and combating erosion. An effective approach is to use contour wattling, willow cuttings, or conventional slope plantings in combination with a low breast wall, gabion revetment, or bench structure constructed at the toe of a slope. Another approach is to grow vegetation in the voids of interstices of structural walls or revetments. The role of vegetation in stabilizing slopes was described; criteria and guidelines for successful wattling or revegetation of slopes were also discussed. Examples and cost comparisons were presented of recent vegetative-structural slope

treatments used in the Lake Tahoe Region of California. (Humphreys-ISWS) W80-03455

**EFFECT OF SEDIMENT CONTROL DAMS ON THE WATER QUALITY OF A PRAIRIE LAKE,**  
South Dakota State Univ. Dept. of Biology.  
L. Haertel.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-147515, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Institute, South Dakota State University, Completion Report, February 1980. 53 p, 2 Fig, 23 Tab, 28 Ref, 2 Append. OWRT A-061-SDAK (1), 14-34-0001-7088.

Descriptors: \*Sediment control, Effects, \*Water quality, \*Lakes, South Dakota, Dams, Pre-impoundment, Post-impoundment, Water analysis, \*Sediment control dams, Algal blooms, Water transparency, Prairie lakes, Nutrient levels.

Water transparency (Secchi disc), algal bloom density (chlorophyll a and cell counts) and nutrient chemistry (NH<sub>3</sub>-N, NO<sub>3</sub>-N, Organic N, Orthophosphate-P and Total P) were sampled on Lake Cochrane, SD from 1976-1979 during and after sediment dam construction. These data were compared with previous data taken from other studies on Lake Cochrane 1970-1975 using the same sampling techniques. Data were separated by season and compared between years by analysis of variance. 1977 and 1978 (1 and 2 years after sediment dam construction) were consistently higher in nutrient levels for all seasons than other years. 1977 (1 year after construction) was poorest in water transparency for all seasons. Erosion off the steep slopes from the construction is probably responsible for the high nutrient levels and low water transparency observed during those years. Unusually low rainfall in 1976 probably prevented erosion from being a problem during the year of construction. Chlorophyll a analysis of variance indicates that 1978 and 1979 were not significantly different from 1970, the year of lowest algal concentrations and best water transparency measured possibly indicating a trend toward improved water quality after sediment dam construction. However, water transparency readings from 1971 to 1979, were significantly poorer than in 1970. Algal species composition also indicated more eutrophic conditions from 1971-1979 than existed in 1970. (Wiersma-South Dakota) W80-03477

**LABORATORY EVALUATION OF METHODS TO SEPARATE FINE GRAINED SEDIMENT FROM STORMWATER,**  
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.  
L. M. Bergstedt, J. M. Wetzel, and J. A. Cardle.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-121528, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Technology Series Report No EPA-600/2-79-076, July 1979. 40 p, 12 Fig, 2 Tab, 4 Ref. R 803579.

Descriptors: \*Separation techniques, \*Erosion control, \*Sediment control, \*Storm runoff, Settling basins, Laboratory tests, Construction, Particle size, Sediments, Flocculation, Water pollution sources, Suspended load, Trap efficiency, Water purification.

Two commercially available solid separation devices, an inclined tube settler and a Discostrainer, were tested to study their ability to remove inorganic solids that are less than 100 microns in size from stormwater. These two devices were selected for testing following a literature survey of the various methods for separation of sediment from stormwater at construction sites. Full-scale units were laboratory tested with influent concentrations of approximately 2000 mg/L. The inclined settler tube, manufactured by Neptune Microfloc, Inc., showed some capability for removing fine, inorganic solids from water. Installation of a settler tube to a sedimentation basin was found to reduce the sensitivity of solid removal to overflow rate. The settler tube increases basin efficiency thereby

reducing the size of the required sedimentation basin. It was also found that the addition of alum to influent caused increased flocculation and increased solids removal by approximately 6%. The performance of the Discostrainer was marginal with 30% removal of solids at an influent concentration of 1300 mg/L and a 10% removal rate at 2100 mg/L. Tests results for the devices indicate great difficulty in separating the desired size solids from water using physical processes. The cost of using such devices at construction sites may not be economically justifiable. (Seigler-IPA) W80-03566

## 5. WATER QUALITY MANAGEMENT AND PROTECTION

### 5A. Identification Of Pollutants

**LABORATORY OBSERVATIONS ON THE INFLUENCE OF TEMPERATURE AND SALINITY ON DEVELOPMENT OF THE EGGS AND GROWTH OF THE LARVAE OF SOLEA SOLEA (PISCES),**  
Nederlands Inst. voor Onderzoek der Zee, Texel. M. Fonds.  
Marine Ecology-Progress Series, Vol 1, p 91-99, 1979. 3 Fig, 6 Tab, 39 Ref.

Descriptors: \*Water temperature, \*Salinity, \*Growth rates, \*Marine fish, Fish eggs, Larval growth stage, Mortality, Salt tolerance, Thermal stress, Fish physiology, Fish behavior, Spawning, \*Sole, \*Solea.

Eggs of the sole *Solea solea* (L.) were incubated at different constant temperatures (10, 13, 16, 19, 22°C) and salinities, 10, 20, 30, 40, 50 o/oo; the larvae were reared at the same temperatures but at one salinity (30 o/oo S). High survival and normal development to hatching were observed at temperatures from 10 to 16°C and salinities from 20 o/oo to 40 o/oo S. The growth rate increased with increasing size of the larvae and also increased with the rearing temperature to a maximum at 22°C. Some environmental factors which may influence the survival of sole eggs and larvae in the sea are discussed. (Deal-EIS) W80-03329

**RESPONSES OF THE FISH BLENNIUS PHOLIS TO FLUCTUATING SALINITIES,**  
Natural Environment Research Council, Bangor (Wales). Marine Invertebrate Biology Unit.  
J. Davenport, and O. Vahl.  
Marine Ecology-Progress Series, Vol 1, p 101-107, 1979. 4 Fig, 2 Tab, 26 Ref.

Descriptors: \*Salinity, \*Toxicity, \*Respiration, Fish physiology, Animal metabolism, Osmosis, Oxygen requirements, Fish behavior, Dissolved oxygen, Cycles, Salt tolerance, \*Blenny, \*Blenius, \*Tissue analysis, \*Blood chemistry, \*Ventilation rates, \*Acclimation.

Blenius pholis (L.) were exposed to fluctuating salinity regimes of near tidal periodicity and their blood osmolality, oxygen consumption, heart rate and opercular beat monitored. Despite salinity fluctuations from 34.0-34.0 o/ooS, the blood osmolality remained constant. Significant increases in oxygen consumption were observed at low salinity levels, but these may simply reflect changes in physical activity and the greater availability of oxygen at low salinities. Salinity effects upon heart rate/opercular beat were weak or negligible. (Deal-EIS) W80-03330

**BENTHIC INVERTEBRATES OF THE LOWER MISSISSIPPI RIVER,**  
Geological Survey, Baton Rouge, La.  
F. C. Wells, and C. R. Demas.  
Water Resources Bulletin, Vol 15, No 6, 1565-1577, 1979. 3 Fig, 1 Tab, 25 Ref.

Identification Of Pollutants—Group 5A

Descriptors: \*Benthic fauna, \*Mississippi River, \*Biological communities, Aquatic populations, Dominant organisms, Worms, Insects, Diptera, Clams, Isopods, Mollusks, Mayflies, Amphipoda, River flow, Aquatic habitats, Water chemistry, Industrial wastes, Municipal wastes.

In 1976-77, benthic invertebrates were sampled at four sites in a 410 kilometer reach of the lower Mississippi River to define the communities in the river and to determine differences between communities upstream and downstream from the industrial and municipal complexes of Baton Rouge and New Orleans, Louisiana. The most common and most numerous organisms collected were Corbicula and tubificid worms. The benthic community structure of the lower Mississippi River is influenced by substrate type and stability, channel geometry, river velocity, vegetation and organic detritus, and salinity. Sampling stations near the left and right banks had low velocities, and substrate types ranged from medium silt to very fine sand. Burrowing organisms such as tubificids, chironomids, and ephemeral-type mayflies dominated these environments. At the center, left-center, and right-center stations, velocities were higher and substrate materials were coarser than at the bank stations; only Corbicula was present in large numbers. Near the river mouth, salinity and aquatic vegetation greatly affect the benthic community structure. Differences in benthic community structure in the Mississippi River are due primarily to different hydrologic conditions. Industrial and municipal wastes discharged into the river appear to have little or no widespread effects on benthic populations. (Deal-EIS) W80-03333

**EVALUATION OF CUTRINE FOR USE IN FISH CULTURE.**  
New York State Dept. of Environmental Conservation, Rome.  
J. C. Skea, and H. A. Simonin.  
The Progressive Fish Culturist, Vol 41, No 4, p 171-174, 1979. 5 Tab, 7 Ref.

Descriptors: \*Algicides, \*Toxicity, \*Bass, \*Minnows, Copper compounds, Bioassay, Mortality, Fish management, Fish hatcheries, Aquatic algae, Water chemistry, Cladophora, \*Cutrine.

Laboratory and field tests were conducted with Cutrine, a chelated copper algicide registered for use in fish hatcheries. The 96-h LC50 for fingerling largemouth bass (*Micropterus salmoides*) was found to be 70 microg/l Cutrine (6.4 mg/l Cu) at 21.1°C and 2.3 microg/l (0.21 mg/l Cu) for fathead minnows (*Pimephales promelas*) at 18.3°C. When Cutrine was applied at a rate of 2.3 microg/l (0.75 gal/A-ft) to half of a rearing pond for fathead minnows, the amount of filamentous algae was substantially reduced. Caged largemouth bass and fathead minnows showed less than 10% mortality in the treated area of the pond. (Deal-EIS) W80-03335

**SAPROLEGNIA: CONTROL OF FUNGUS ON INCUBATING EGGS OF PINK SALMON BY TREATMENT WITH SEAWATER.**  
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.  
S. G. Taylor, and J. E. Bailey.  
The Progressive Fish-Culturist, Vol 41, No 4, p 181-183, 1979. 3 Tab, 6 Ref.

Descriptors: \*Fish eggs, \*Fungicides, \*Pink Salmon, \*Sea water, Fish management, Fish hatcheries, Mortality, Fish diseases, Disinfection, Growth stages, \*Saprolegnia, \*Malachite green.

Daily 2- to 3-h treatments with seawater safely and effectively controlled Saprolegnia dielina on eggs of pink salmon (*Oncorhynchus gorbuscha*) in two trials at Auke Creek Hatchery, southeastern Alaska. Survival in gravel incubators from the fertilized-egg stage to the fry stage was significantly higher ( $P < 0.005$ ) with seawater treatment (68%) than with no treatment (41%). In tray incubators, survival from the fertilized-egg stage to the eyed-egg stage averaged 95% for the 1971 to 1976 broods after malachite green treatments and 96%

for the 1977 brood after seawater treatments. (Deal-EIS) W80-03336

**IODOPHOR DISINFECTION OF MUSKELLUNGE EGGS UNDER INTENSIVE CULTURE IN HATCHERIES.**

New York State Dept. of Environmental Conservation, Rome.  
J. H. Schachte, Jr.  
The Progressive Fish Culturist, Vol 41, No 4, p 189-190, 1979. 1 Tab, 6 Ref.

Descriptors: \*Disinfection, \*Fish hatcheries, \*Fish management, Iodine, Pikes, Fish eggs, Toxicity, Mortality, Fish reproduction, Pathogenic bacteria, Bactericides, Fish diseases, \*Iodophors.

The iodophor Povidone-Iodine (1% active I2) was used at three concentrations, 100, 28, and 13 mg/l (1:100, 1:350, and 1:750) for 10 min. in an attempt to disinfect fertilized eggs of muskellunge (*Esox masquinongy*) and to test the efficacy and toxicity of the compound on the eggs of cool-water species. No treatment effect was observed between treatments and controls or among treatments. However, no toxic effects of the iodophor were found at the concentrations of active I2 considered efficacious for salmonids. (Deal-EIS) W80-03337

**INHIBITION OF CARBON FIXATION AS A FUNCTION OF ZINC UPTAKE IN NATURAL PHYTOPLANKTON ASSEMBLAGES.**

Marine Biological Association of the United Kingdom, Plymouth (England), Plymouth Lab.  
A. G. Davies, and J. A. Sleep.  
Journal of the Marine Biological Association of the United Kingdom, Vol 59, p 937-949, 1979. 2 Fig, 4 Tab, 29 Ref.

Descriptors: \*Zinc, \*Inhibition, \*Photosynthesis, \*Phytoplankton, Radiochemical analysis, Tracers, Zinc radioisotopes, Carbon radioisotopes, Chlorophyll, Absorption, Mode of action, Plant physiology, Toxicity, Heavy metals, Analytical techniques, \*Tissue analysis, \*Bioaccumulation.

By developing a method for discriminating between the radioactivities of  $^{14}\text{C}$  and  $^{65}\text{Zn}$ , it has proved possible to measure the influence of zinc upon the carbon fixation rates of natural phytoplankton communities as a function of both the zinc concentrations in the water and the zinc/chlorophyll a ratios in the plant cells. Photosynthesis in the phytoplankton assemblages in the English Channel during July 1978 was found to be inhibited at zinc concentrations which have been reported to be present in the waters of some other coastal regions around the British Isles. Zinc/chlorophyll a ratios in the phytoplankton were related to the zinc levels in the water by an expression analogous to the Langmuir adsorption isotherm and, presumably due to the near saturation of the zinc binding sites in the plant cells, began to approach their maximal values at zinc concentrations above about 30 microg/l. As the carbon fixation rates were linearly correlated with the zinc/chlorophyll a ratios, these too began to level-off at about the same concentration, higher zinc values causing very little further inhibition. The experimental data are shown to be in good agreement with an expression which describes the effect of zinc upon carbon fixation rates in phytoplankton simply in terms of the zinc binding capacity of the cells and the zinc concentration in the water. This indicates that, as in cultures, the growth rates of natural phytoplankton are also governed by the cellular contents of rate-limiting constituents rather than by the concentrations in the water. (Deal-EIS) W80-03340

**A COMPARATIVE STUDY OF THE CLOSURE RESPONSES OF SOME CIRRIPEDE SPECIES EXPOSED TO FALLING SEAWATER CONCENTRATIONS.**

Natural Environment Research Council, Bangor (Wales). Marine Invertebrate Biology Unit.  
D. F. Cawthorne.  
Journal of the Marine Biological Association of the

United Kingdom, Vol 59, p 811-817, 1979. 5 Fig, 12 Ref.

Descriptors: \*Animal behavior, \*Salinity, Salt tolerance, Habitats, Adaptation, Animal physiology, Sea water, Estuarine environment, Osmosis, Membrane processes, Physiological ecology, \*Barnacles.

The closure response to low external salinity of three species of intertidal and estuarine barnacle (*Balanus balanoides*, *B. crenatus* and *Elminius modestus*) when exposed to various rates of salinity change were investigated. Comparisons were made between the responses of specimens collected from estuarine and coastal sites. In addition the responses of the brackish water barnacle *Balanus improvisus* were measured. Three species, *B. crenatus*, *B. improvisus* and *E. modestus* showed no sensitivity to rate of salinity change except at extremely high and unphysiological rates of concentration change. *B. balanoides* exhibited a sensitivity to rate of salinity change, closure occurring at lower sea water concentrations, with slow rates of change. There was no difference between the response of estuarine and coastal specimens of this species, whilst in *B. crenatus* and *E. modestus*, estuarine specimens closed at a significantly lower concentration for a given rate of salinity change. (Deal-EIS) W80-03342

**EUGLENACEA AND CHRYSOPHYCEAE AS ORGANISMS INVOLVED IN POLLUTION OF THE MARINE LITTORAL (IN FRENCH).**

Institut Roman de Recherches Marines, Constantza, Romania.

F. E. Mihnea.  
In: 11<sup>es</sup> journées d'études sur les pollutions marines en Méditerranée, Commission Internationale Pour L'Exploration Scientifique De La Mer Méditerranée, Monaco, 24-27 Novembre 1978, Antalya, Turkey, p 471-475, 1979. 9 Fig, 4 Ref, (English summary).

Descriptors: Algae, Phytoplankton, Phosphates, Nutrients, Plant physiology, Marine algae, Water pollution effects, Nutrients, Biochemical oxygen demand, Laboratory tests, Bioassays, Growth, Water temperature.

Both the frequency and the biological cycle of Euglenaceae and Chrysophyceae, as well as their correlation with environmental conditions, are analysed. The optimum temperature, positive correlation with CB05, P-P04, and the ratio N/P; all explain the occurrence and the development of the unicellular algae groups studied. The relationship of these algae to the environmental variables explain their role in the purification of the marine littoral. Algae demonstrate their ability to adapt to a wide range of water temperatures. (Katz-EIS) W80-03345

**MEIOFAUNA DEVELOPMENT ON ARTIFICIAL SOFT BOTTOMS IN KIEL BAY (IN GERMAN).**

Kiel Univ. (Germany, F.R.). Zoologisches Inst. W. Scheibel, and H. Rumohr.  
Helgolander wissenschaftliche Meeresuntersuchungen, Vol 32, p 305-312, 1979. 5 Fig, 2 Tab, 9 Ref, (English summary).

Descriptors: \*On-site tests, \*Dominant organisms, Biological communities, Nematodes, Benthic fauna, Sediments, Aquatic populations, Biomass, Analytical techniques, Research equipment, \*Colonization, \*Harpacticoides, \*Baltic Sea.

The 'Benthosgarten', an enclosed area in the western Baltic Sea, is used for benthos ecology experiments. It consists of different kinds of sediment containers filled with 'artificial' soft bottom. These containers were sampled by divers over a one-year period to observe the development of the meiofauna population. The first settlement, mainly by nematodes, took place immediately after exposure, and six months later the population was stabilized. The meiofauna consists mainly of nematodes and harpacticoides. Biomass and density are generally lower than in the surrounding area. Only the har-

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

pactoid fauna is well represented by different species and has more individuals per sqm than the surrounding area. Biological aspects of the specific features of the sediment containers, e.g. size and their distance to the sea bottom are discussed. (Deal-EIS)  
W80-03346

**TRACE ELEMENT RELEASE FROM ESTUARINE SEDIMENTS OF SOUTH MOSQUITO LAGOON NEAR KENNEDY SPACE CENTER, Savannah State Coll., GA.**  
M. P. Menon, G. S. Ghuman, and C. O. Emeh. Water, Air, and Soil Pollution, Vol 12, No 3, p 295-306, October 1979. 3 Fig, 3 Tab, 25 Ref. NASA NSG803.

Descriptors: \*Analytical techniques, \*Chemical analysis, \*Trace elements, \*Metals, Lagoons, Sediments, Sampling, Laboratory tests, Ions, Zinc, Manganese, Cadmium, Copper, Pollutants, Pollutant identification, Water pollution, Estuaries.

Analytical partitioning of four trace metals in estuarine sediments collected from eight sites in South Mosquito Lagoon, near Kennedy Space Center, in terms of four different categories was accomplished using four different extraction techniques. The concentrations of the four trace metals, Zn, Mn, Cd, and Cu, released in interstitial water extract, 1 N ammonium acetate extract, conc. HCl extract, and fusion extract of sediments as well as their concentrations in water samples collected from the same location were determined using flame atomic absorption technique. From the analytical results the percentages of total amount of each metal distributed among four different categories, interstitial water phase, acetate extractable, acid extractable, and detrital crystalline material, were determined. Our results suggested that analytical partitioning of trace metals in estuarine sediments may be used to study the mechanism of incorporation of trace metals with sediments from natural waters. A correlation between the seasonal variation in the concentration of acetate-extractable trace metals in the sediment and similar variation in their concentration in water was observed. A mechanism for the release of trace metals from estuarine sediments to natural water was also suggested. (Sims-ISWS)  
W80-03355

**USE OF SYNOGRAPHIC TECHNIQUES IN RESEARCH AND DISSEMINATION OF HYDROLOGICAL INFORMATION,**  
Texas Univ. at Houston. School of Public Health. For primary bibliographic entry see Field 7C.  
W80-03360

**THE PROBLEM OF PHOSPHORUS IN THE EUTROPHIC LAKE MARYUT,**  
Alexandria Inst. of Oceanography and Fisheries (Egypt). For primary bibliographic entry see Field 5B.  
W80-03371

**SAFEGUARDS FOR GROUNDWATER,**  
For primary bibliographic entry see Field 6E.  
W80-03422

**ORGANIC QUALITIES OF GROUNDWATERS,**  
Arizona Univ., Tucson. Dept. of Civil Engineering. D. R. Kasper, and K. S. Knickerbocker. Available from the National Technical Information Service, Springfield, VA 22161 at PB80-147267, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center, University of Arizona. Project Completion Report, February 1980. 15 p, 3 Fig, 3 Tab, 5 Ref, OWRT A-067-ARIZ(1), 14-34-0001-6003.

Descriptors: \*Organic wastes, \*Percolation, Groundwater, \*Activated sludge, Path of pollutants, Sampling, Water wells, Water analysis, Water supply, \*Colorform extract method, Groundwater organics, Wastewater recharge, Groundwater quality, Tucson(Ariz).

The total organic content or recharged secondary effluents as measured by the miniaturized carbon chloroform extract method (CCE-m) was investigated by analyzing waters from wells located at various distances from recharge areas. It was found that the CCE-m organic concentration decreased with increasing percolation distance. Secondary activated sludge effluent was found to contain 3.80 mg/l CCE-m. Percolation through 100 feet of porous media reduced the CCE-m value to less than 0.50 mg/l. This is less than the EPA proposed 1974 Drinking Water Standard of 0.70 mg/l. Fourteen wells located a minimum of 1,000 feet from an ephemeral stream receiving secondary effluent had CCE-m values less than 0.20 mg/l. A general survey of deep wells known not to receive any wastewater recharge found CCE-m values varying from 0.04 to 0.30 mg/l. It is probable that the oil lubrication methods employed in deep wells resulted in these CCE-m values.  
W80-03437

**LONGEVITY AND REPRODUCTION OF DAPHNIA PULEX (DE GEER) EXPOSED TO CADMIUM-CONTAMINATED FOOD OR WATER,**  
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies. P. E. Bertram, and B. A. Hart. Environmental Pollution, Vol 19, p 295-305, 1979. 4 Fig, 2 Tab, 18 Ref. OWRT A-023-VT(2).

Descriptors: \*Cadmium, \*Toxicity, \*Daphnia, Chlorella, Chlorophyta, Reproduction, Life history studies, Fertility, Fecundity, Heavy metals, Path of pollutants, Absorption, Crustaceans, Chemical analysis, \*Tissue analysis, \*Bioaccumulation.

The effect of cadmium on the survival and reproductive capacity of *Daphnia pulex* was determined. Cadmium was present either in the water at chronic (1-30 microgram Cd/litre) and acute (40-90 microgram Cd/litre) levels or in the algal food source, *Chlorella pyrenoidosa*. The average longevity of *D. pulex* was not affected by exposure to 1 microgram Cd/litre but it was reduced in a dose-dependent manner between 5 and 30 microgram Cd/litre. Exposure to cadmium had no effect on the number of days to onset or frequency of reproduction but it did cause a reduction in the percentage of adults producing young, the number of broods per adult, the number of young per brood, the number of progeny per adult, the intrinsic rate of natural increase (*r*), and the mean generation time (*T*). Cadmium-laden *Chlorella* caused the same effects as did exposure to 1 microgram Cd/litre. (Deal-EIS)  
W80-03439

**QUALITY OF RUNOFF FROM LAND RECEIVING SURFACE APPLICATION AND INJECTION OF LIQUID DAIRY MANURE,**  
Kentucky Univ., Lexington. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 5B.  
W80-03443

**MONITORING OF TOTAL AMOUNT OF LIPOPHILIC ORGANO CHLORINE COMPOUNDS IN A SWEDISH RIVER,**  
Goteborg Univ. (Sweden). Institutionen for Analytisk Kemi. For primary bibliographic entry see Field 5B.  
W80-03458

**EFFECTS OF LIMESTONE STRIP MINING ON BENTHIC MACROINVERTEBRATE COMMUNITIES,**  
Calgary Univ. (Alberta). Dept. of Biology. For primary bibliographic entry see Field 5C.  
W80-03460

**MODIFIED AMPEROMETRIC MEMBRANE PROBES FOR DETERMINING FREE AND TOTAL RESIDUAL CHLORINE IN SALINE COOLING WATERS,**  
Central Electricity Generating Board, Leatherhead (England). Research Labs.

N. A. Dimmock, and D. Midgley. Water Research, Vol 13, No 12, p 1317-1327, 1979. 7 Fig, 2 Tab, 9 Ref.

Descriptors: \*Chlorine, \*Cooling water, \*Instrumentation, Equipment, Chemistry, Salinity, Potassium compounds, Hydrogen ion concentration, Chemical reactions, Water chemistry, Chemical analysis, Electrodes, Membrane probes.

Modifications have been made to a Delta Scientific model 82124 free available chlorine probe so that it can be used to determine either the free or the total residual chlorine in cooling waters at coastal and estuarine power stations. For measurements of free residual chlorine, the internal filling solution of the probe was changed for one containing potassium bromide at pH 4. When the sample solution was dosed with potassium bromide and pH 4 buffer, the probe had a linear response over the range 0.04-1.0 microgram/milliliter Cl<sub>2</sub>, and errors caused by changes in salinity were negligible. Total standard deviations for the analysis of 1.0 and 0.1 microgram/milliliter Cl<sub>2</sub> solutions were 0.055 and 0.01 microgram/milliliter Cl<sub>2</sub>, respectively. For measurements of total residual chlorine a potassium iodide solution at pH 4 was used as the probe's internal filling solution, and the sample solution was dosed with potassium iodide and pH 4 buffer. The probe had a linear response over the range 0.02-0.5 microgram/milliliter Cl<sub>2</sub>, with total standard deviations of 0.05 and 0.01 microgram/milliliter Cl<sub>2</sub> at concentrations of 0.5 and 0.1 microgram/milliliter Cl<sub>2</sub>, respectively. (Sims-ISWS)  
W80-03462

**AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF PHOSPHORUS,**  
Foras Forbartha, Dublin (Ireland). L. J. Lennox. Water Research, Vol 13, No 12, p 1329-1333, 1979. 4 Fig, 4 Tab, 6 Ref.

Descriptors: \*Analytical techniques, \*Chemical analysis, \*Phosphorus, \*Water chemistry, Chemistry, Water pollution, Pollutants, Nutrients, Pollutant identification, Phosphorus compounds, Sewage, Sewage effluents, Fertilizers, Rivers, Lakes, Reservoirs.

Procedures for the determination of dissolved orthophosphate and total phosphorus in surface fresh waters (e.g., rivers, lakes, and reservoirs) and organic wastes (e.g., domestic sewage, creamery effluents, and the like) (particulate or dissolved) were described. Total phosphorus compounds were converted to orthophosphate by acid persulfate digestion. The digestion time was 3 h which goes to completion without any supervision. The method allowed for a maximum of 36 samples, 2 blanks, and 2 standards to be processed simultaneously. There was no pH adjustment required. Interference from silica and iron (III) up to 20 mg/l was absent. Detection limits for the automated step involving orthophosphate were 1 microgram/liter. Recovery and effectiveness of proposed procedures were excellent. (Sims-ISWS)  
W80-03463

**HUMIC AND FULVIC ACIDS AS INDICATORS OF SOIL AND WATER POLLUTION,**  
Department of Agriculture, Ottawa (Ontario). Chemistry and Biology Research Inst. H. Kerndorff, and M. Schnitzer. Water, Air, and Soil Pollution, Vol 12, No 3, p 319-329, October 1979. 6 Fig, 7 Tab, 20 Ref.

Descriptors: \*Indicators, \*Water pollution, \*Soil contamination, \*Humic acids, \*Fulvic acids, Sampling, Surveys, Sediments, Pollutants, Pollutant identification, Chemicals, Chemical analysis, Analytical techniques, Carbon, Hydrogen, Nitrogen, Sulfur, Oxygen, Statistical analysis, Data processing.

Humic substances are the major organic components of soil and sediments, but little is known on how they are affected by environmental and industrial pollution. To find out whether such effects could be recognized, a number of analytical characteristics were compared of humic and fulvic

acids extracted from unpolluted and polluted soils and sediments. The main differences were that, per unit weight, polluted humic and fulvic acids contained more N, S, and H but fewer CO<sub>2</sub>H groups, and were more aliphatic than unpolluted samples. Unusually high N and S contents of humic materials appear to be the most valid indicators of pollution. Humic acids are preferred to fulvic acids as indicators of pollution because the former are more readily separated and purified. (Sims-ISWS) W80-03465

#### AERIAL INPUTS OF CADMIUM, COPPER, LEAD, AND MANGANESE INTO A FRESH-WATER POND IN THE VICINITY OF A COAL-FIRED POWER PLANT,

Savannah River Ecology Lab., Aiken, SC.

J. G. Wiener.

Water, Air, and Soil Pollution, Vol 12, No 3, p 343-353, October 1979. 5 Tab, 34 Ref. DOE EY-76-C-09-0819.

Descriptors: \*Chemistry of precipitation, \*Metals, \*Air pollution, \*Water pollution sources, \*Powerplants, \*South Carolina, Fly ash, Coals, Sampling, Rainfall, Precipitation (Atmospheric), Laboratory tests, Chemical analysis, Cadmium, Copper, Lead, Manganese, Data processing, Regression analysis.

Cadmium, Cu, Mn, and Pb were analyzed in bulk precipitation for 21 months at a 2-ha pond, located 3.5 km northwest of an 83 MW coal-fired power plant in South Carolina. No significant changes in mean concentrations of the four metals in bulk precipitation were observed after installation of modern electrostatic precipitators on the stacks of the power plant, which previously had been equipped with mechanical cyclone collectors for removal of fly ash. Hence, fly ash from stack emissions was apparently not a major source of aerically deposited trace metals at the pond site. Annual inputs of the four metals in bulk precipitation at the pond were similar to values reported for other rural areas in North America. Enrichment factors, with Mn as a reference element, indicated that Cd, Cu, and Pb in bulk precipitation were not derived from soil or crustal material. Cadmium, Cu, and Pb were enriched in all samples of bulk precipitation relative to their abundances in local soils and were most enriched during autumn and winter. A multiple regression procedure suggested that wetfall was the primary mode of aerial deposition of Cd and Cu, whereas both wetfall and dryfall were important modes of aerial deposition of Pb. (Sims-ISWS) W80-03466

#### IMPACT OF NUTRIENT ENRICHMENT IN A WATERCHESNUT ECOSYSTEM AT TAKAHAMA-IRI BAY OF LAKE KASUMIGAURA, JAPAN—I. NUTRIENT INFLUX AND PHYTOPLANKTON BLOOM,

Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.

H. Seki, M. Takahashi, and S. Ichimura.

Water, Air, and Soil Pollution, Vol 12, No 3, p 383-391, October 1979. 9 Fig, 19 Ref.

Descriptors: \*Algae, \*Eutrophication, \*Lakes, \*Nutrients, Water pollution effects, Agricultural runoff, Agricultural chemicals, Farm wastes, Fertilizers, Water pollution, Pollutants, Water temperature, Chlorophyll, Dissolved oxygen, Bacteria, Phosphates, Nitrogen compounds, Phytoplankton, Sampling, Limnology, \*Japan.

The heaviest algal bloom that can be expected in an aquatic system was formed in a waterchestnut ecosystem in Lake Kasumigaura during the summer in 1978 when the water temperature was greater than 30°C, caused by the nutrient discharges from the River Koise and the River Sanno. The heavy bloom not only threatens the steady-state equilibrium of the eutrophic system of the lake but also must accelerate the lake transformation into a low moor by forming ooze on the lake bottom with the precipitation of a large amount of dead blue-green algae. (Sims-ISWS) W80-03467

#### PRODUCTION OF HALOFORM PRECURSORS BY WATER PIPE BACTERIAL FILMS,

Missouri Univ.-Rolla. Dept. of Civil Engineering. D. B. Jacques, and D. K. Muckerman. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-147002. Price codes: A04 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, University of Missouri. Completion Report. November 1979. 61 p, 12 Fig, 10 Tab, 25 Ref. USDI-OWRT-14-34-0001-9027, A-108-MO (1).

Descriptors: Bacteria, Chlorination, \*Trihalomethanes, Chloroform, Slime.

The objective of this investigation was to determine the potential for bacteria films coating the interior of water distribution lines to act as organic precursors to the formation of trihalomethanes (THMs). Experiments were conducted in a static manner by chlorinating one foot sections of four inch diameter cast iron pipe which contained a film of bacteria native to the Rolla, Mo tap water system. A water pipe bacterial film was demonstrated to act as an organic precursor for chlorinating a set of pipes with and without a bacterial film. A clean pipe and a chlorine dose of 2.5 mg/l established a 24 hour baseline total THM (TTHM) production level of 4 ug/l for the Rolla tap water. Including the bacterial aline growth increased the TTHM level to 19 ug/l at a chlorine dose of 2.9 ug/l. Further increasing the chlorine dose to 94 mg/l produced a TTHM level of 86 ug/l at the end of 24 hours. The pH of the Water was shown to have a definite influence on THM production. At a chlorine dose of 0 mg/l, varying the pH from 5.3 to 8.7 increased TTHM production from six to 98 ug/l during a 24 hour test. Throughout the investigation, chloroform was found to be the predominant THM species. The average breakdown of THM species resulting from the chlorination of bacterial films can be summarized as follows: 79% chloroform, 17% bromodichloromethane, and four % dibromochloromethane. Bromoform was present, but usually at concentrations less than one ug/l. W80-03478

#### DISTRIBUTION OF METALS IN STREET SWEEPINGS, STORMWATER SOLIDS, AND URBAN AQUATIC SEDIMENTS,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.

For primary bibliographic entry see Field 5B.

W80-03543

### 5B. Sources Of Pollution

#### ENVIRONMENTAL PATH OF ARSENIC IN GROUNDWATER,

Alaska Univ., Fairbanks. Inst. of Water Resources. D. B. Hawkins.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143662. Price codes: A02 in paper copy, A01 in microfiche. Report No IWR-77, 1976. 7 p, OWRT A-050-ALAS (2), 14-34-0001-6002.

Descriptors: \*Arsenic, \*Alaska, \*Path of pollutants, \*Groundwater, Streams, Mining, \*Ester Dome area (Alaska), \*Pedro Dome-Clearly Summit area (Alaska).

This study determined the arsenic concentration in water of the Fairbanks Mining District. Stream waters had a mean of 24 parts per billion (ppb) of arsenic, and a maximum of 1200 ppb in the Pedro Dome-Clearly Summit area. A positive correlation of arsenic content of stream water and that of suspended and bottom sediment was demonstrated. Significant arsenic contamination of domestic well waters was also revealed in the Ester Dome area. Thirty to 50 percent of the 100 wells sampled had concentrations of arsenic over 50 ppb. The U.S. Public Health Service recommends a limit of 10 ppb, and rejects water with 50 ppb arsenic as a public water supply. The relationships between arsenic contamination and both mining activity and gold mineralization are discussed. W80-03303

### Sources Of Pollution—Group 5B

#### A STUDY OF THE CHARACTERISTICS AND POLLUTION POTENTIAL OF LAND SPREAD DOMESTIC SEPTAGE ON GROUNDWATER QUALITY,

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.

G. R. Beehler, and J. A. Moore.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143670. Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center, University of Minnesota Report, January 1980. 48 p, 6 Fig, 28 Tab, 26 Ref, 2 Append, OWRT A-036-MINN (1).

Descriptors: \*Septic tank sludge, \*Soil treatment, \*Water pollution effects, Septage spreading, Infiltration, Groundwater, Path of pollutants.

A three-year study was undertaken to establish the characteristics of septage in Minnesota and to evaluate the effects of land spreading of domestic septage on groundwater nitrate concentration and microbial penetration. TS, TVS, pH, COD, NH<sub>3</sub>-N, TKN, conductivity and fecal coliforms were examined on 75 samples from two septage haulers. Large variations were noted in all parameters with septage in the Brainerd area possessing mean values 50% lower than septage in the White Bear Lake area. Seven virgin plots were identified and two types of application were proposed. Intermittent spreading initiated actual spreading practices and received + 3,000 gallons per plot per day. Slug loads were utilized to maximize the hydraulic load and pollution potential of the septage applied. Four plots of intermittent loading received 174,000, 169,000, 32,000 and 39,000 gallons of septage during the three-year study. This gallonage represented a total nitrogen application equivalent to 2,400, 1,100, 630 and 290 lbs N/acre. No significant increase in well water nitrates was observed. Slight increases of nitrate nitrogen concentrations were observed in the soil profiles, most notably at the heaviest application of nitrogen applied. Slug loads of 200 to 2,000 gallons per single application on 10 foot x 50 foot plots failed to increase well water nitrate concentrations and only infrequent instances of fecal coliform recovery occurred. These may represent sporadic penetration or be of an iatrogenic source and may or may not be a significant finding. (Blake-Minn) W80-03306

#### ACCUMULATION, ELIMINATION, AND METABOLISM OF DICHLOROBENZIDINE IN THE BLUEGILL SUNFISH,

Syracuse Research Corp., NY. Life Sciences Div. H. T. Appleton, and H. C. Sikka.

Environmental Science and Technology, Vol 14, No 1, p 50-54, 1980. 6 Tab, 22 Ref.

Descriptors: \*Animal metabolism, \*Sunfishes, \*Organic compounds, Absorption, Chemical properties, Chemical wastes, Carbon radioisotopes, Tracers, Fish physiology, Path of pollutants, Public health, \*Carcinogens, \*Tissue analysis, \*Bioaccumulation, \*Dichlorobenzidine (DCB).

The bioconcentration, elimination, and metabolism of 3,3'-dichloro-benzidine (DCB), a suspected human carcinogen, were investigated in bluegill sunfish. (14C)DCB was rapidly accumulated by the fish from water containing 5 ppb or 0.1 ppm of the chemical. Based on total 14C residues, bioconcentration factors of 495 to 507 were observed in the whole fish with equilibria achieved in 96 to 168 h. The 14C residues were distributed in both the edible and nonedible portions. (14C)DCB or its metabolites were not completely eliminated upon transfer of the fish to water free of dichlorobenzidine. The only metabolite detected in the fish was an acid-labile conjugate of DCB, which appears to be an N-glucuronide. The ability of DCB to concentrate in aquatic organisms may present a direct hazard to human health through consumption of contaminated fish. (Deal-EIS) W80-03334

#### TWO HEAVY METAL-BINDING PROTEINS IN THE MIDGUT GLAND OF THE CRAB CARCINUS MAENAS,

Queen Mary Coll., London (England). Dept. of

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

Zoology and Comparative Physiology.

P. S. Rainbow, and A. G. Scott.

Marine Biology, Vol 55, p 143-150, 1979. 4 Fig, 6 Tab, 29 Ref.

Descriptors: \*Crabs, \*Proteins, \*Heavy metals, Biochemistry, Animal metabolism, Animal physiology, \*Cadmium, \*Zinc, \*Copper, \*Lead, Path of pollutants, Chemical properties, \*Tissue analysis, \*Bioaccumulation, \*Midgut gland.

Two heavy metal-binding proteins occur naturally in the midgut glands of *Carcinus maenas* (L.) collected from the Firth of Clyde, Scotland. These proteins, of approximately 27,000 and 11,500 MW (molecular weight) have previously been described as Cd-binding proteins after their induction by high concentrations of cadmium in the laboratory. The approx. 27,000 MW heavy metal-binding protein is bound to about 0.10 g-at of Cd, 0.70 g-at of Zn and 0.31 g-at of Cu per mole of protein; 7.7, 7.9 and 1.1%, respectively, of the soluble Cd, Zn and Cu in the midgut gland are associated with this approx. 27,000 MW protein (6.7, 1.6 and 0.9% of the total midgut gland Cd, Zn and Cu). The approx. 11,500 MW protein is bound to about 0.04 g-at of Cd, 0.37 g-at of Zn and 1.54 g-at of Cu per mole of protein; 29.3, 31.3

W80-03339

#### INHIBITION OF CARBON FIXATION AS A FUNCTION OF ZINC UPTAKE IN NATURAL PHYTOPLANKTON ASSEMBLAGES

Marine Biological Association of the United Kingdom, Plymouth (England), Plymouth Lab.

For primary bibliographic entry see Field 5A.

W80-03340

#### ZINC—A MAJOR INORGANIC COMPONENT OF NEREID POLYCHAETE JAWS

Marine Biological Association of the United Kingdom, Plymouth (England), Plymouth Lab.

G. W. Bryan, and P. E. Gibbs.

Journal of the Marine Biological Association of the United Kingdom, Vol 59, p 969-973, 1979. 3 Tab, 6 Ref.

Descriptors: \*Zinc, \*Worms, \*Habitats, Animal metabolism, Animal physiology, Heavy metals, Chemical analysis, Baseline studies, Bottom sediments, Spectrophotometry, \*Polychaetes, \*Tissue analysis, \*Bioaccumulation.

Analyses of the jaws of nereid polychaetes have shown zinc to be a major inorganic component amounting to between 0.5 and 2.4% of the dry weight and accounting for up to 40% of the total body burden of zinc. In *Nereis diversicolor*, zinc concentrations in the jaws are not related to those of the habitat sediments. A high zinc content appears to be a structural characteristic of the nereid jaw. (Deal-EIS)

W80-03341

#### TOTAL MERCURY CONTENT IN SOME MARINE FISH FROM THE INDIAN OCEAN

National Inst. of Oceanography, Goa (India).

T. W. Kureishy, M. D. George, and R. S. Gupta. Marine Pollution Bulletin, Vol 10, p 357-360, 1979. 1 Fig, 1 Tab, 16 Ref.

Descriptors: \*Mercury, \*Marine fish, \*Path of pollutants, Chemical analysis, Heavy metals, Water chemistry, Chemical wastes, Food chains, Fish physiology, Animal metabolism, Lipids, Sharks, \*Tissue analysis, \*Bioaccumulation, \*Tuna, \*Dolphin, \*Methylmercury.

Total mercury was estimated in liver, gonads and muscle of some of the marine fishes from the Indian Ocean. The highest mercury concentration was observed in the muscle of sharks while the total mercury concentration was practically non-detectable in the liver and gonads. The range of all the values was 0.09-0.21 ppm (wet weight basis) and is quite low to reflect any possible mercury contamination. (Deal-EIS)

W80-03343

#### USE OF SYNOGRAPHIC TECHNIQUES IN RESEARCH AND DISSEMINATION OF HYDROLOGICAL INFORMATION

Texas Univ. at Houston, School of Public Health.

For primary bibliographic entry see Field 7C.

W80-03360

#### THE PROBLEM OF PHOSPHORUS IN THE EUTROPHIC LAKE MARYUT

Alexandria Inst. of Oceanography and Fisheries (Egypt).

S. D. Wahby, and M. A. A. El-Moneim.

Estuarine and Coastal Marine Science, Vol 9, No 5, p 615-622, November 1979. 3 Fig, 1 Tab, 18 Ref.

Descriptors: \*Lakes, \*Eutrophication, \*Phosphorus compounds, \*Sewage disposal, Coasts, Brackish water, Sewage, Water pollution, Water pollution sources, Environmental effects, Water pollution effects, Algae, Phosphorus, Sampling, Monitoring, Pollutants, Pollutant identification, Path of pollutants, Limnology, \*Egypt, \*Lake Maryut (Egypt).

Lake Maryut receives untreated sewage and industrial wastes in its main basin. Its phosphorus content has increased by about 128 times in the past 15 years. Signs of eutrophication are clear. Analysis of inorganic phosphate in the different parts of the lake has been carried out, and the annual phosphorus loading was calculated to be 13.1 mg/l/year which is very high. (Sims-ISWS)

W80-03371

#### A COMPARISON OF THE AXIAL DISTRIBUTIONS OF SALT AND 137CS IN THE SEVERN ESTUARY DURING AUGUST 1974

Institute for Marine Environmental Research, Plymouth (England).

R. J. Uncles.

Estuarine and Coastal Marine Science, Vol 9, No 5, p 585-594, November 1979. 4 Fig, 1 Tab, 12 Ref.

Descriptors: \*Dispersion, \*Estuaries, \*Salinity, \*Radioisotopes, Pollutants, Path of pollutants, Water pollution, Cesium, Salts, Powerplants, Nuclear powerplants, Water pollution sources, Sampling, Monitoring, Coasts, Tidal waters, Data processing, \*United Kingdom, \*Severn estuary (UK).

A comparison was made of the axial distributions of salt and dissolved <sup>137</sup>Cs in a seaward section of the Severn estuary during August 1974. It was shown that these variables were distributed with essentially the same axial dispersion coefficient, and that conditions were effectively stationary. It was also shown that the flushing of <sup>137</sup>Cs from the estuary during this period was mainly due to the axial dispersion. The observed concentrations of <sup>137</sup>Cs were the linear summation of those due to the northeast Celtic Sea and freshwater background levels (0.65 0.06 pCi/l and approximately 0.08 pCi/l respectively), together with those produced by the three nuclear power generating stations which discharge <sup>137</sup>Cs into the estuary. The levels due to the Celtic Sea background amounted to roughly 50% of the observed values, taken as an average over the study area; the levels due to the freshwater background were negligible. (Sims-ISWS)

W80-03373

#### LONGITUDINAL DISPERSION IN RIVERS

National Water Research Inst., Burlington (Ontario).

S. Beltaos.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY1, Proceedings Paper 15118, p 151-172, January 1980. 9 Fig, 30 Ref, 1 Append.

Descriptors: \*Dispersion, \*Rivers, \*Mixing, \*Model studies, Mathematical models, Pollutants, Path of pollutants, Water pollution, On-site data collections, Calibrations, Streams, Streamflow, Turbulence, Hydraulics.

To explain the frequent deviation of longitudinal dispersion observations in rivers from the Fickian

dispersion theory, a two-parameter model was developed. This model was based on reevaluation of the mixing length concept and the assumption that the characteristic irregularity of rivers retards the onset of the Fickian process. The model suggested that there are three distinct dispersion ranges. Within a characteristic stream length from the source, the temporal spread of the dispersing cloud increases linearly with distance; concentration-time curves at different locations along the stream are similar and can be predicted if a dimensionless coefficient is known. The Fickian process occurs at distances exceeding about three times the characteristic stream length. Transitional behavior occurs in the intermediate range. Published field data were analyzed to test the model and evaluate the dispersion parameters. The river length marking onset of Fickian dispersion was found to be up to 30 times that of a corresponding prismatic channel; it was estimated that Fickian dispersion is not likely to occur within lengths of practical interest in any but small streams. (Sims-ISWS)

W80-03378

#### THE SURVIVAL OF COLIFORM BACTERIA IN SALINE SEDIMENTS

New South Wales Univ., Kensington (Australia). School of Microbiology.

M. M. Roper, and K. C. Marshall.

Australian Water Resources Council Technical Paper No 43, 1979. 73 p, 46 Fig, 2 Tab, 77 Ref.

Descriptors: \*Coliforms, \*E. coli, \*Sewage bacteria, \*Sediments, Water quality, \*Australia, Biocontrol, Bacteriophage, Saline water, Colloids, Bacteria, Animal parasites, Amoebae, Montmorillonite, Clays.

Studies in the Tamar and Georges Rivers in Australia indicate: (1) that coliform bacteria were deposited in bottom muds when the electrolyte concentration (salinity) exceeded a critical conductivity of .25 mmhos cm, and (2) that sediment particulates prolong the survival of the bacteria. Research revealed that biological parasites (bacteriophage, Bdellovibrio), lytic bacteria (Polyangium), and predatory amoebae (Vexillifera) are the major biological agents that rapidly destroy faecal bacteria in natural waters. A colloidal envelope formed around *E. coli* appears to protect the bacteria from attack. Anaerobic conditions encountered below the sediment-water interface inhibit some agents but not bacteriophage. Dilution of the electrolyte beyond the critical concentration causes the *E. coli* and other organisms to be desorbed and the sediment colloids to be dispersed. In saline lagoons and estuaries, which are subjected to changes in salinity, *E. coli* and possibly other faecal microorganisms could present a health hazard if desorbed by dilution as a result of heavy rainfall. (Schaefer-IPA)

W80-03386

#### TRIAZINE RESIDUES IN A WATERSHED IN SOUTHWESTERN ONTARIO (1973-75)

Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.

G. C. Roberts, G. J. Siron, R. Frank, and H. E. Collins.

Journal of Great Lakes Research, Vol 5, No 3-4, p 246-255, 1979. 1 Fig, 7 Tab, 11 Ref.

Descriptors: \*Agricultural runoff, \*Herbicides, \*Pesticide residues, \*Triazine pesticides, Organic pesticides, Watersheds (Basins), Water sampling, Clays, Water pollution sources, Pesticide removal, Lake Erie, Ontario, Erosion, Agricultural watersheds.

Creek water from sites on the lower reaches of Hillman Creek in southwestern Ontario was tested to investigate the movement of triazine, a herbicide, in the stream. Hillman Creek drains into Lake Erie from a watershed of 4500 ha. The watershed is largely sandy loam soils with podsol clay subsoils. Questionnaire results from a farm-to-farm survey in the watershed indicate that 30% of the cropland was treated with s-triazine in 1973 and 1974. During these years water samples were taken from six sites and in 1974 and 1975 26 sites were sampled. Integrated samples of 3 to 4 liters were

## Sources Of Pollution—Group 5B

taken at each site and flow data were used to calculate herbicide loadings. Three fish species, gizzard shad, black crappie, and brown bullheads, were also tested. Results show that triazines residues were consistently higher upstream than downstream. Specific residues were found in the following percentages of samples: atrazine 89%, desethylatrazine 51%, Simazine 37%, metribuzin 4.4% cyanazine 0.6%, and cyprazine 0.3%. A high of 34.7 micrograms/l Simazine was observed for June and July. Overall only a small fraction (0.3% to 2%) of the applied herbicides reached the stream. Transfer occurs during runoff and is not connected to steady leaching. Most triazines are adsorbed by clay colloids and organic matter. No triazine herbicide residues were found in the fish analyzed. Broadleaf and annual grasses are expected to be the most triazine susceptible aquatic plants. (Seigler-IPA)  
W80-03389

### EXECUTIVE SUMMARY OF THE REPORT 'SURFACE IMPOUNDMENTS AND THE EFFECTS OF GROUND WATER QUALITY IN THE UNITED STATES—A PRELIMINARY SURVEY'

Gieraghty and Miller, Inc., Tampa, FL.  
EPA Report No EPA-570/9-78-005, June, 1978, 30 p, 1 Fig, 1 Tab.

Descriptors: \*Impoundments, \*Ground water, \*Water quality, Surface water, Water pollution control, Ponds, Lagoons, Seepage, Farm wastes, Industrial wastes, Municipal wastes, Waste disposal, Surveys.

This report summarizes the results of an investigation of the use of municipal, industrial, and agricultural surface impoundments in the United States, with particular reference to the potential threats they may pose to the quality of underground drinking water resources and to methods of controlling or abating such threats. The principal subjects covered in the investigation are: (1) numbers, types and uses of impoundments, (2) chemical characteristics of the impounded wastes, (3) mechanisms by which wastes that seep from impoundments may contaminate ground water, (4) selected case history data on ground water contamination, (5) technical controls and costs for preventing and alleviating contamination, and (6) state regulatory controls over the use of impoundments. (Purdin-NWWA)  
W80-03424

### MIGRATION OF RADIONUCLIDE CHAINS IN GROUND WATER

Ford, Bacon and Davis Utah, Inc., Salt Lake City. V. C. Rogers.  
Nuclear Technology, Vol 40, No 10, p 315-320, October, 1978. 5 Fig, 1 Tab, 7 Ref.

Descriptors: \*Radioisotopes, \*Migration, \*Ground water, Diffusion, Mass transfer, Uranium radioisotopes, Radium radioisotopes, Equations.

Expressions are presented for determining the maximum concentrations and discharge rates of radioactive nuclide chains migrating by flowing ground water. Nuclide migration is determined from a second-order differential mass balance equation that considers longitudinal dispersion, convection, sorption, and radioactive decay. These expressions are presented for two-member chains that quantify the recontamination effect in terms of dimensionless parameters. These parameters demonstrate the interrelationships between the basic nuclide and adsorbing medium parameters. The recontamination effect for the third member of three-member chains is adequately described by the two-member expressions, except the range of recontamination is extended. This approach provides a relatively simple method of determining an upper limit to the concentrations or release rates of parent and daughter radionuclides in ground water. (Purdin-NWWA)  
W80-03433

### LONGEVITY AND REPRODUCTION OF DAPHNIA PULEX (DE GEER) EXPOSED TO

CADMIUM-CONTAMINATED FOOD OR WATER,  
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.  
For primary bibliographic entry see Field 5A.  
W80-03439

### QUALITY OF RUNOFF FROM LAND RECEIVING SURFACE APPLICATION AND INJECTION OF LIQUID DAIRY MANURE

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.  
I. J. Ross, S. Sizemore, J. P. Bowden, and C. T. Haan.  
Transactions of the American Society of Agricultural Engineers, Vol 22, No 3, p 1038-1062, September-October 1979. 11 Fig, 2 Ref. OWRT B-047-KY(2).

Descriptors: \*Farm wastes, \*Application methods, \*Runoff, \*Water quality, On-site investigations, Injection, Sampling, Chemical analysis, Pollutants, Hydrogen ion concentration, Chemical oxygen demand, Nitrogen, Suspended solids, Coliforms, Dissolved oxygen, Soils, Grasses, Agriculture, Land application.

Liquid dairy manure was applied to the surface and injected into sod and bare soil. Runoff from plots receiving these treatments was analyzed for COD, N, TS, TSS, pH, DO, and fecal coliform. Injection greatly reduced the concentration of these pollutants in the runoff. (Sims-ISWS)  
W80-03443

### SCIENTIFIC ASPECTS OF THE 1975-76 DROUGHT IN ENGLAND AND WALES

For primary bibliographic entry see Field 2E.  
W80-03444

### POLLUTION PROBLEMS ARISING FROM THE 1975-76 DROUGHT

Anglian Water Authority, Huntingdon (England).  
For primary bibliographic entry see Field 2E.  
W80-03449

### ALGAL AND INVERTEBRATE COMMUNITIES IN THREE SUBARCTIC LAKES RECEIVING MINE WASTES

For primary bibliographic entry see Field 5C.  
W80-03457

### MONITORING OF TOTAL AMOUNT OF LIPOPHILIC ORGANO CHLORINE COMPOUNDS IN A SWEDISH RIVER

Goteborg Univ. (Sweden). Institutionen for Analytisk Kemi.  
M. Ahnoff, B. Josefsson, G. Lunde, and G. Andersson.  
Water Research, Vol 13, No 12, p 1233-1237, 1979. 3 Fig, 3 Tab, 12 Ref.

Descriptors: \*Chlorine, \*Rivers, \*Monitoring, Organic compounds, Organic pesticides, Water pollution, Water quality, Pollutants, Sampling, Pollutant identification, Chemical analysis, Neutron activation analysis, Water pollution sources, Path of pollutants, \*Sweden, \*Gota River(Sweden).

A sensitive method for the determination of organic bound chlorine in river water has been used in a monitoring program. The amount of organic bound chlorine, extracted by cyclohexane and determined by neutron activation analysis, was chosen as a parameter for detection and tracing of pollutants with annoying or harmful properties. During one year, 216 samples, each collected continuously during 48 h, were taken at seven stations, located at 7-23 km distance along the Gota River, Sweden. The detection limit of the method was below 0.05 microgram Cl/l. Major sources of pollution were localized to certain sections of the river. (Sims-ISWS)  
W80-03458

### ONE-DIMENSIONAL TRANSIENT MODEL FOR SHORT-TERM PREDICTION OF DOWNSTREAM POLLUTION IN RIVERS,

Vienna Univ. (Austria). Inst. of Meteorology and Geophysics.  
P. Kahlig.  
Water Research, Vol 13, No 12, p 1311-1316, 1979. 4 Fig, 14 Ref, 1 Append.

Descriptors: \*Dispersion, \*Tracers, \*Rivers, \*Model studies, Mathematical models, Pollutants, Path of pollutants, Water pollution, Streams, Streamflow, Flumes, Laboratory tests, On-site investigations, Equations, Mathematics, Mixing, Hydrology.

Using an exact solution of Taylor's dispersion equation (including forced convection and a first-order removal process), the author derived a new routing procedure for short-term prediction of downstream pollution, and compared it to H.B. Fischer's wellknown method. An interaction between the dispersion and removal processes was demonstrated, and its usual negligible effect in river dispersion problems was justified. (See also W69-02368) (Sims-ISWS)  
W80-03461

### HUMIC AND FULVIC ACIDS AS INDICATORS OF SOIL AND WATER POLLUTION

Department of Agriculture, Ottawa (Ontario). Chemistry and Biology Research Inst.  
For primary bibliographic entry see Field 5A.  
W80-03465

### AERIAL INPUTS OF CADMIUM, COPPER, LEAD, AND MANGANESE INTO A FRESH-WATER POND IN THE VICINITY OF A COAL-FIRED POWER PLANT

Savannah River Ecology Lab., Aiken, SC.  
For primary bibliographic entry see Field 5A.  
W80-03466

### IMPACT OF NUTRIENT ENRICHMENT IN A WATERCHESTNUT ECOSYSTEM AT TAKAHAMA-IRI BAY OF LAKE KASUMIGaura, JAPAN—I. NUTRIENT INFLUX AND PHYTOPLANKTON BLOOM

Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.  
For primary bibliographic entry see Field 5A.  
W80-03467

### ROAD DE-ICING SALTS IN AN URBAN STREAM AND FLOOD CONTROL RESERVOIR

Ontario HYDRO, Toronto.  
W. S. Scott.  
Water Resources Bulletin, Vol 15, No 6, p 1733-1742, December 1979. 7 Fig, 1 Tab, 10 Ref.

Descriptors: \*Reservoirs, \*Flood control, \*Deicers, \*Salts, \*Canada, \*Environmental effects, Highway effects, Water quality, Chlorides, Sodium, Runoff, Streams, Road salt.

High concentrations of chloride and sodium were found in the bottom layers of a new flood control reservoir at the beginning of winter thaw periods. The reservoir had a number of significant downstream impacts. After short thaw periods, discharge from the bottom of the reservoir tended to cause higher salt concentrations downstream in comparison with upstream sites. During long thaw periods or when large quantities of rain fell, downstream salt concentrations were considerably less than upstream values. Average chloride and sodium content of soil at the bottom of the reservoir more than doubled as a result of impounding runoff waters for one winter. (Visocky-ISWS)  
W80-03468

### PROXIMITY OF PIPELINES AND STORAGE FACILITIES FOR GAS AND OIL TO MAJOR AQUIFERS IN CONNECTICUT

Geological Survey, Hartford, CT. Water Resources Div.  
For primary bibliographic entry see Field 7C.  
W80-03479

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

**WATER-QUALITY DATA FOR LANDFILLS, HILLSBOROUGH COUNTY, FLORIDA, JANUARY 1974-OCTOBER 1977.**  
Geological Survey, Tallahassee, FL. Water Resources Div.  
M. Fernandez, Jr., and R. R. Hallbourg.  
Geological Survey open-file report 78-820, 1979. 112 p, 5 Fig, 6 Tab, 2 Ref.

**Descriptors:** \*Water quality, \*Landfills, \*Water analysis, \*Groundwater, \*Florida, Data collections, Path of pollutants, Observation wells, Well data, Chemical analysis, Metals, Trace elements, Nitrogen, Phosphorus, Coliforms, Herbicides, Pesticides, Chemical oxygen demand, Biochemical oxygen demand, \*Hillsborough County (Fla).

Periodic water-quality data were collected at four landfills in Hillsborough County, Florida, from January 1974 through October 1977. Water samples were analyzed for nitrogen and phosphorus species, cations, trace metals, chloride, specific conductance, chemical oxygen demand, biological oxygen demand, and coliforms. Select groundwater samples were analyzed for herbicide and pesticide. Results of chemical and bacteriological analysis from four landfills are presented as basic data. Geologic logs and well descriptions are presented for wells drilled at the landfills after January 1974. (Kosco-USGS)  
W80-03489

**IMPACTS OF COAL-FIRED POWER PLANTS ON FISH, WILDLIFE AND THEIR HABITATS.**  
Argonne National Lab., IL. Environmental Impact Studies.  
For primary bibliographic entry see Field 4C.  
W80-03518

**DISTRIBUTION OF METALS IN STREET SWEEPINGS, STORMWATER SOLIDS, AND URBAN AQUATIC SEDIMENTS.**  
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.  
W. G. Wilber, and J. V. Hunter.  
Journal of the Water Pollution Control Federation, Vol 51, No 12, p 2810-2822, December 1979. 3 Fig, 8 Tab, 22 Ref. OWRT-A-050-NJ (4), 14-34-0001-9032.

**Descriptors:** \*Heavy metals, \*Urban runoff, \*Stormwater, \*Water pollution, \*New Jersey, Sampling, Sediments, Metals, Rivers, Runoff, Solid wastes, Suspended solids, Cities, Chemicals, Chemical analysis, Water pollution sources, Path of pollutants, \*Lodi (NJ), \*Saddle River (NJ), Street sweepings, Non-point pollution.

The chemical availability of heavy metals in street sweepings, stormwater solids, and sediments from an urban area was determined based on their solubility in Saddle River (New Jersey) water, exchangeability with ammonium acetate, and association with easily reducible manganese oxides, organic matter, and moderately reducible iron oxides. An average of less than 1% of the total metals in the solids studied were soluble in Saddle River water at pH 7.4. The concentration of metals in street sweepings and stormwater solids exchangeable with  $\text{NH}_4\text{OAc}$  (pH 7.0) was significant and, in the case of lead and zinc, comprised more than 20% of the total concentration. An average of 16.7% of the metals in the solids studied were bound to organic matter, with copper being the most tightly bound. With the exception of manganese and copper in sediments of the Saddle River, the fraction associated with moderately reducible iron oxides accounted for greater than 50% of the total metal concentrations. (Sims-ISWS)  
W80-03543

**INVESTIGATION OF SANITARY LANDFILL BEHAVIOR, VOLUME I. FINAL REPORT.**  
Drexel Univ., Philadelphia, PA.  
A. A. Fungaroli, and R. L. Steiner.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-209 000. Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Technology Series Report No EPA-600/2-79-053a, July 1979. 330 p,

205 Fig, 33 Tab, 21 Ref, 1 Append. R800777 and R801947.

**Descriptors:** \*Landfills, \*Sanitary engineering, \*Waste disposal, \*Leachate, Infiltration, Soil chemistry, Percolation, Path of pollutants, Soil water, Subsurface drainage, Groundwater movement, Solid wastes, Gases, Wastes, Lysimeters.

A six year study of sanitary landfill behavior identified a semi-log linear relationship between contaminant concentration and leachate volume. An experimental sanitary landfill field site was monitored for gas generation, leachate migration, and groundwater contamination. The site was a 50 ft by 50 ft area with 11 ft of refuse covered by 2 ft of soil. Leachate quantity and pollution removal were recorded with a lysimeter in a laboratory sanitary landfill. At the field site accelerated column tests predicted long-term landfill behavior and identified the stabilization effects of depth and added nutrients. Various sizes of milled refuse were tested and the chemical components of leachates were correlated with each other and with leachate volume. Results were used to develop a two-dimensional model of leachate migration patterns. Good correlation was obtained from computer solutions and average field concentrations. Results show that once an entire landfill system is brought to field capacity the generation of leachate is in direct relationship to the volume of water added to the system. Leachate generation is dependent on initial moisture contents, landfill density, rate of filling, and water infiltration quantities. Leachate production is attributed to the refuse, channeling, an advance wetting front, or a main wetting front. Extensive conclusions are provided. (Seigler-IPA)  
W80-03567

**DISPOSAL OF DREDGED MATERIAL WITHIN THE NEW YORK DISTRICT: VOLUME I-PRESENT PRACTICES AND CANDIDATE ALTERNATIVES.**  
MITRE Corp., McLean, VA. METREK Div.  
W. G. Conner, D. Aurand, M. Leslie, J. Slaughter, and A. Amr.  
Performed for U.S. Army Corps of Engineers, New York District, May 1979. MITRE Technical Report MTR-7808. 360 p, 34 Fig, 59 Tab, 321 Ref, 5 Append. DACW51-C-77-0061.

**Descriptors:** \*Dredging, \*Waste disposal, \*Management alternatives, \*Ocean dumping, \*Contaminants, \*Disposal, \*Dredged material, \*New York, Land treatment, New York Bight, Chemical effects, Biological effects, Socioeconomic effects, Channels, Marine ecosystems, Federal Water Pollution Control Act Amendments, Borrow pits, Wetlands.

The two volumes of this report present results of a detailed evaluation of the dredged material ocean disposal program of the New York District of the U.S. Corps of Engineers. While there is clearly a need for continued dredging in the area, there are major environmental problems, mostly centered around the disposal of dredged material containing such contaminants as heavy metals, petroleum compounds, and synthetic organic compounds. Volume I examines the current program and its impacts in the New York Bight. Annual volumes of material dredged between 1970 and 1976 ranged from 8 to 19.5 million cubic yards. Area conditions which might signify environmental degradation include low water bottom oxygen content, declining commercial fish harvests, and increased incidence of fish diseases and kills. Continued dumping of dredged material and the current Mud Dump disposal site would probably directly affect only a relatively small area of the bottom. Alternatives were sorted into three categories: not currently reasonable, possible in special cases, and possible in special cases and feasible for larger volumes of dredged material. Three alternatives were placed in the third category and are most likely to provide acceptable disposal in the area: shallow ocean disposal, subaqueous borrow pits, and confined upland disposal. Open ocean disposal is recommended only as a last alternative. Measures to reduce the volume of dredged material include selective dredging and sediment control. (Arnold-NC)

W80-03586

**MEASUREMENTS OF VERTICAL FLOW IN GROUND WATER BORINGS AND HYDROLOGICAL PARAMETERS FOR ASSESSING GROUND WATER POLLUTION.**  
Bhabha Atomic Research Centre, Bombay (India). U. Chandra.  
Mausam, Vol 30, No 1, p 3-8, January 1979. 8 Fig, 14 Ref.

**Descriptors:** \*Groundwater, \*Boreholes, \*Groundwater movement, \*Water pollution, On-site investigations, Flow, Aquifers, Water pollution sources, Equipment, Instrumentation, Rivers, Garbage dumps, Industrial wastes, Hydrology, Path of pollutants, Vertical groundwater flow.

Some measurements of vertical flow in borings in karst dolomite aquifer by the use of an electromechanical device were reported. Field studies undertaken to assess groundwater pollution due to releases from a refinery complex, garbage disposal site, and a heavily polluted river were described. (Sims-ISWS)  
W80-03599

### 5C. Effects Of Pollution

**A STUDY OF THE CHARACTERISTICS AND POLLUTION POTENTIAL OF LAND SPREAD DOMESTIC SEPTAGE ON GROUNDWATER QUALITY.**  
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 5B.  
W80-03306

**THE KILLING OF RUSH CREEK.**  
Minnesota Department of Natural Resources, Rochester.  
J. A. Schneider.  
Water Spectrum, Vol 12, No 1, p 38-43, Winter 1979. 9 Fig.

**Descriptors:** \*Fishkill, \*Pesticide toxicity, \*Minnesota, \*Agricultural runoff, Surface runoff, Trout, Suckers, Turbidity, Water temperature, Dissolved oxygen, Ammonia, Water pollution effects, Erosion control, Wet seasons, Rainfall, Cholinesterase inhibition.

The May 20, 1978 fishkill along 13 miles of Rush Creek in Minnesota and other similar fishkills prompted a full scale investigation into the causes for the deaths. A common factor involved in all of the kills seemed to be rainfall heavy enough to cause washing and erosion from row crop fields. The most severe kills occurred during the May planting season every year. To pursue the theory that agricultural chemicals were causing the kills a staff of trained and experienced people from several agencies were assembled including the Extension Service, the Environmental Protection Agency, The Federal Fish and Wildlife Service, and the Minnesota Department of Natural Resources. A sampling program was designed that could be rapidly implemented the following year during May if the fishkills were repeated. Sampling procedures selected included: tests for pH, temperature, turbidity, ammonia, and dissolved oxygen; and a simple field test for detecting cholinesterase inhibition. Fishkills did occur in May and June and samples of moribund and freshly killed suckers were tested. The cholinesterase inhibition test gave excellent results indicating death due to poisoning probably from organo-phosphate-based insecticides for controlling corn rootworm larvae. Better farming practices to control erosion and runoff are needed to help prevent future kills. (Seigler-IPA)  
W80-03318

**LABORATORY OBSERVATIONS ON THE INFLUENCE OF TEMPERATURE AND SALINITY ON DEVELOPMENT OF THE EGGS AND GROWTH OF THE LARVAE OF SOLEA SOLEA (PISCES).**

Effects Of Pollution—Group 5C

Nederlands Inst. voor Onderzoek der Zee, Texel.  
For primary bibliographic entry see Field 5A.  
W80-03329

**RESPONSES OF THE FISH BLENNIUS PHOLIS TO FLUCTUATING SALINITIES,**  
Natural Environment Research Council, Bangor (Wales). Marine Invertebrate Biology Unit.  
For primary bibliographic entry see Field 5A.  
W80-03330

**ACCUMULATION, ELIMINATION, AND METABOLISM OF DICHLOROBENZIDINE IN THE BLUEGILL SUNFISH,**  
Syracuse Research Corp., NY. Life Sciences Div.  
For primary bibliographic entry see Field 5B.  
W80-03334

**EVALUATION OF CUTRINE FOR USE IN FISH CULTURE,**  
New York State Dept. of Environmental Conservation, Rome.  
For primary bibliographic entry see Field 5A.  
W80-03335

**FUNDAMENTAL STUDIES ON THE INFLUENCE OF OIL POLLUTION UPON MARINE ORGANISMS—IV THE TOXICITY OF MIXTURES OF OIL PRODUCTS AND OIL-SPILL EMULSIFIERS TO PHYTOPLANKTON (IN JAPANESE),**  
Tokyo Univ. (Japan). Dept. of Fisheries.  
H. Tokuda.  
Bulletin of the Japanese Society of Scientific Fisheries, Vol 45, No 10, p 1289-1291, 1979. 3 Tab, 6 Ref. (English Abst).

Descriptors: \*Oil pollution, \*Toxicity, \*Diatoms, Oil, Oil spills, Fuels, Emulsifiers, Chemical properties, Growth rates, Aquatic algae, Phytoplankton, \*Dispersants, \*Oil dispersants.

The toxicity of mixtures of several oil products and oil-spill emulsifiers to the growth of a marine diatom *Skeletonema costatum* was compared with that of individual oil products and oil-spill emulsifiers. The following results were obtained: the toxicity of all the mixtures tested is by far higher than that of individual oil-spill emulsifiers, but is similar to or slightly higher than that of the corresponding individual oil products. (Deal-EIS)  
W80-03338

**INHIBITION OF CARBON FIXATION AS A FUNCTION OF ZINC UPTAKE IN NATURAL PHYTOPLANKTON ASSEMBLAGES,**  
Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab.  
For primary bibliographic entry see Field 5A.  
W80-03340

**COLD SHOCK: EFFECT OF RATE OF THERMAL DECREASE ON ATLANTIC MENHADEN,**  
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.  
D. T. Burton, P. R. Abell, and T. P. Capizzi.  
Marine Pollution Bulletin, Vol 10, p 347-349, 1979. 1 Fig, 1 Tab, 19 Ref.

Descriptors: \*Thermal stress, \*Powerplants, \*Fish physiology, Mortality, Water temperature, Juvenile growth stage, Regression analysis, Mathematical models, Cold resistance, Fish behavior, \*Atlantic menhaden, \*Acclimation.

This study was designed to assess the effects of various rates of thermal decrease on mortality of juvenile Atlantic menhaden (*Brevoortia tyrannus*) which may result from winter shutdown of large power plant facilities. Temperatures were lowered from 15 to 5°C at rates of decrease which ranged from 27.0 to 0.4/hr. A significant correlation was found between rate of thermal decrease and mortality. The relationship between percent mortality and rate of decrease was best described by a piecewise regression curve with two rates; one rate

where mortality was high and a second where mortality decreased rapidly as the rate of temperature reduction decreased. (Deal-EIS)  
W80-03344

**EUGLENACEA AND CHRYSOPHYCEAE AS ORGANISMS INVOLVED IN POLLUTION OF THE MARINE LITTORAL (IN FRENCH),**  
Institut Romania de Recherches Marines, Constanta.  
For primary bibliographic entry see Field 5A.  
W80-03345

**MEIOFAUNA DEVELOPMENT ON ARTIFICIAL SOFT BOTTOMS IN KIEL BAY (IN GERMAN),**  
Kiel Univ. (Germany, F.R.). Zoologisches Inst.  
For primary bibliographic entry see Field 5A.  
W80-03346

**PHOSPHORUS RECYCLE AND CHLOROPHYLL IN THE GREAT LAKES,**  
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.  
D. M. Di Toro, and W. F. Matystik.  
Journal of Great Lakes Research, Vol 5, No 3-4, p 233-245, 1979. 6 Fig, 2 Tab, 21 Ref.

Descriptors: \*Great Lakes, \*Lake Erie, \*Lake Huron, \*Lake Ontario, \*Phosphorus, \*Cycling nutrients, Eutrophication, Chlorophyll, Phytoplankton, Aquatic life, Algae, Kinetics, Limnology, Productivity, Water pollution effects.

A model of the kinetics of phosphorus recycling rates and their relationship to chlorophyll concentrations and phytoplankton populations was developed for Lake Huron, Lake Ontario, Saginaw Bay, and other Great Lakes areas. To simply theoretically characterize, the recycling process nutrients are divided into three forms: plankton-bound, available, and unavailable. From these divisions a kinetic formulation for the recycling is developed. These formulations indicate a decline in the ratio of unavailable to total phosphorus with increasing chlorophyll concentrations. This simple theoretical analysis with steady state and constant parameters is applied to long time average epilimnion data for areas in Lake Erie, Lake Huron, Lake Ontario, and Saginaw Bay. Results from this application suggest an inverse relationship between the unavailable portion of both total and soluble phosphorus and chlorophyll. Assumptions that the phosphorus recycling rate is a saturating function of chlorophyll produce consistent agreement with the same phytoplankton and recycle kinetic constants. Computations for Lake Huron illustrate that for the lower range of chlorophyll concentrations percentage increases in phosphorus discharge are larger than strictly proportional increases in chlorophyll. For Lake Huron a two-fold increase in phosphorus loading produces approximately a four-fold algal chlorophyll increase. (Seigler-IPA)  
W80-03388

**RESPONSES OF FRESHWATER BENTHOS TO OPEN-LAKE DREDGED SPOILS DISPOSAL IN LAKE ERIE,**  
Texas Univ. at Austin, Port Aransas. Marine Science Inst.  
R. W. Flint.  
Journal of Great Lakes Research, Vol 5, No 3-4, p 264-275, 1979. 5 Fig, 4 Tab, 21 Ref.

Descriptors: \*Lake Erie, \*Dredging, \*Disposal, \*Benthic fauna, Bottom sediments, Sands, Mud, Water sampling, Oligochaetes, Invertebrates, Benthos, Aquatic populations, Distribution patterns, Environmental effects, Worms, Larvae.

Temporal variations in the natural benthic macroinvertebrate community of areas subjected to open-lake dredged spoil disposal were examined in Lake Erie near Ashtabula. The two types of dredged spoil used were sandy-silt sediment from the Ashtabula harbor and coarser sand sediments from the Ashtabula River. Two untreated reference sites were also sampled for comparison. Ponar grab samples were used to characterize the

communities at the sources of dredging to determine the types of material that would be deposited at the spoil sites. Samples were taken at the disposal and control sites at intervals of 5 days, 90 days, 256 days, and 340 days after disposal. For each sample taken a modified Spade box corer was used to collect four replicate bottom samples. Macroinvertebrates were identified to the lowest taxa possible. Results show that for the sandy silt site the density of macroinvertebrates increased while diversity decreased. Species brought in with the river and harbor sediments contributed to the increased density. Also while the untreated sites had communities of 60 to 80% oligochaetes both disposal sites had communities of 98% oligochaetes. The river spoils disposal sites showed a more rapid recovery to predisposal conditions. The opportunistic nature of the Oligochaeta life history patterns allows them to take advantage of and thrive in the environment existing after disposal. This dominance of Oligochaeta along with the increased population density form unstable communities at the disposal sites. (Seigler-IPA)  
W80-03391

**A SELECTED BIBLIOGRAPHY OF THE LIFE REQUIREMENTS OF COLONIAL NESTING WATERBIRDS AND THEIR RELATIONSHIP TO DREDGED MATERIAL ISLANDS,**  
Army Engineer Waterways Experiment Station, Vicksburg, MS.  
M. C. Landin.  
Miscellaneous Paper D-78-5, September 1978. 52 p.

Descriptors: \*Birds, \*Bibliographies, \*Water birds, Islands, Environmental effects, Dredging, \*Dredged material, \*Colonial birds.

An extensive bibliography of pertinent research on the life requirements of colonial nesting waterbirds in the United States and their relationship to dredged material. An additional bibliography of 181 references pertaining to the vegetation and soils on dredged material islands and environmental impacts of dredged material deposition on waterbird habitats is also presented. Selected references from Canada, Europe, and Africa that pertain to related waterbirds or those introduced to the United States are included. This report provides the reader access to little-known sources and gives localized data on waterbird species that are not otherwise readily available. References from years 1844 to 1978 are included. (WES)  
W80-03393

**EVALUATION OF DREDGED MATERIAL POLLUTION POTENTIAL,**  
Army Engineer Waterways Experiment Station, Vicksburg, MS.  
J. M. Brannon.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A059 724. Price codes: A03 in paper copy, A01 in microfiche. Technical Report DS-78-6, August 1978. 39 p, 36 Ref.

Descriptors: \*Aquatic environment, \*Water pollution, \*Dredging, \*Wastes, Forecasting, Environmental effects, Water quality, Benthos, \*Dredged material.

Synthesizes data from seven research projects that investigated pollution properties of dredged material and procedures for determining their potential for effect on water quality and aquatic organisms. Short-term impact of dredged material on water quality and aquatic organisms is related to the concentration of chemically mobile, readily available contaminants rather than total concentration. The Elutriate Test, which measures concentrations of contaminants released from dredged material, can be used to evaluate short-term impacts on water quality. The only constituents generally released from dredged material are manganese and ammonium -N. Elevated concentrations of these constituents, however, are of short duration because of rapid mixing and are of low frequency due to the intermittent nature of most disposal operations. Short-term chemical and biological impacts of dredging and disposal have generally been minimal. Longer term impacts of dredged material on

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

water quality have generally been slight and can be evaluated by means of the Elutriate Test and analysis of mobile forms of sediment contaminants. The greatest hazard of dredged material disposal is the potential effect of material on benthic organisms. Most dredged material has not proven particularly toxic. Some dredged material, however, can be extremely toxic or of unknown toxicological character. (WES)  
W80-03395

**EFFECTS OF ORGANIC COMPOUNDS ON AMPHIBIAN REPRODUCTION,**  
Kentucky Water Resources Research Inst., Lexington.  
J. Birge, A. Black, and A. Kuehne.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-147523. Price codes: A03 in paper copy, A01 in microfiche. Research Report No 121, 1980. 45 p, 3 Fig, 5 Tab, 44 Ref. OWRD A-074-KY(2), 14-34-0001-7038.

Descriptors: Water quality, \*Organic compounds, Phenols, \*Amphibians, Reproduction, Toxicity, Lethal limit, \*Water pollution effects, Embryo-Larval tests, Atrazine, Carbon Tetrachloride, Chloroform, Methylene chloride.

Aquatic toxicity tests were conducted with atrazine, carbon tetrachloride, chloroform, methylene chloride, trisodium nitrotriacetic acid (NTA), and phenol. Each compound was administered to developmental stages of three to five amphibian species. Exposure was initiated at fertilization and maintained through 4 days post-hatching. Test responses included lethality and teratogenesis. Different amphibian species exhibited varying degrees of tolerance to the selected compounds. Greatest tolerance usually was observed for the more broadly adapted semi-aquatic and terrestrial species (e.g., *Bufo americanus*, *Bufo fowleri*). The more sensitive amphibians usually included those species which normally are restricted to aquatic or moist habitats (e.g., *Rana catesbeiana*, *Rana pipiens*). Median lethal concentrations (mg/l) determined at 4 days posthatching ranged from 0.41 to 48 for atrazine, 0.90 to 2.83 for carbon tetrachloride, 0.27 to 35.14 for chloroform, 17.78 to >32 for methylene chloride, 39.3 to 252.3 for NTA, and 0.04 to >0.89 for phenol. The most toxic compounds always included phenol, carbon tetrachloride, and atrazine, and the least toxic consistently were NTA and methylene chloride. For three chlorinated alkanes, including methylene chloride, chloroform, and carbon tetrachloride, toxicity increased with chlorination. Toxicity of the different compounds was further characterized by calculating concentrations which produced embryo-larval lethality or teratogenesis at frequencies of 10% and 1%. (Huffsey-Ky)  
W80-03438

**LONGEVITY AND REPRODUCTION OF DAPHNIA PULEX (DE GEER) EXPOSED TO CADMIUM-CONTAMINATED FOOD OR WATER,**  
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.  
For primary bibliographic entry see Field 5A.  
W80-03439

**ALGAL AND INVERTEBRATE COMMUNITIES IN THREE SUBARCTIC LAKES RECEIVING MINE WASTES,**  
J. W. Moore, D. J. Sutherland, and V. A. Beaubien.  
Water Research, Vol 13, No 12, p 1193-1202, 1979. 4 Fig, 4 Tab, 28 Ref.

Descriptors: \*Lakes, \*Water pollution, \*Biological communities, \*Canals, Mine wastes, Metals, Chemicals, Pollutants, Arsenic, Lead, Copper, Heavy metals, Hardness(Water), Phytoplankton, Zooplankton, Algae, Daphnia, Biota, Sampling, Chemical analysis, Subarctic, Limnology, Biology, Cyanide.

The effects of liquid mine wastes on the density, species composition, and diversity of phytoplankton and zooplankton were determined between

May 1977 and May 1978 in a series of three small, shallow lakes (Meg, Keg, Peg Lakes) situated in the Canadian subarctic. The concentrations of the most common toxicants fluctuated widely during the study in each of the lakes. Meg Lake was the most polluted, with the concentrations of arsenic, lead, cyanide, and copper reaching 3.0, 0.65, 0.60, and 0.65 g/cu m, respectively. Although the levels of arsenic and lead in the other two lakes were roughly similar to those recorded in Meg Lake, cyanide and copper usually fell below detectable limits. Overall, changes in the level of contamination were poorly correlated with variations in the abundance of the flora and fauna. While phytoplankton (*Chlamydomonas lapponica*, *Aphanoceros microspora*) were common in Meg Lake, reaching densities of 200 mg/cu m, zooplankton were either rare or absent. Algal populations in Keg and Peg Lakes, which were dominated by *Chlamydomonas lapponica* and *Oocystis parva*, attained maximum densities of 200 and 150 mg/cu m, respectively. The most common zooplankton, *Keratella quadrata*, maintained populations of up to 20000-40000 animals/cu m, and was followed in abundance by *Daphnia middendorffiana* and *Cyclops bicuspidatus thomasi*. It was concluded that: (1) the prevalent species may have developed a resistance to metals; (2) taxa not previously associated with heavy metal contamination may have the ability to adapt to pollution; and (3) high arsenic and lead levels probably had less impact on zooplankton than on phytoplankton under field conditions. (Sims-ISWS)  
W80-03457

**THE EFFECT OF WASTEWATER PHOSPHORUS REMOVAL ON SHAGAWA LAKE, MINNESOTA: PHOSPHORUS SUPPLIES, LAKE PHOSPHORUS AND CHLOROPHYLL A,**  
Corvallis Environmental Research Lab., OR.  
D. P. Larsen, J. Van Sickle, K. W. Malueg, and P. D. Smith.  
Water Research, Vol 13, No 12, p 1259-1272, 1979. 8 Fig, 9 Tab, 48 Ref.

Descriptors: \*Water pollution effects, \*Lakes, \*Phosphorus, \*Chlorophyll, \*Minnesota, Water pollution, Water pollution control, Sewage treatment, Water quality control, Algae, Nutrients, Pollutants, Pollutant identification, Phosphorus compounds, Sampling, Chemical analysis, Limnology, \*Shagawa Lake(MN).

In early 1973, the phosphorus supply to Shagawa Lake, Minnesota, was reduced by about 80% when a tertiary wastewater treatment plant began operating. Significant reductions in total and soluble reactive phosphorus concentrations have occurred in the lake since that time. By 1976 the average (volume weighted over the entire lake) total and soluble reactive phosphorus concentrations had declined from about 51 and 21 micrograms/liter to about 30 and 4.5 micrograms/liter, respectively, corresponding to 40 and 80% reductions. During 1975 and 1976, chlorophyll a (averaged over the top 5 m) had decreased to less than 50% of the pretreatment level during May-June, but during July-August little change had occurred. A phosphorus residence time model projected equilibrium total phosphorus concentrations of about 12 micrograms/liter within 1.5 years. The fact that this level was not reached was attributed to a feedback of phosphorus from the sediments, primarily during summer. This phenomenon was incorporated into a modified total phosphorus mass balance model which projects the phosphorus pattern through 1976 quite accurately. The close fit of the modified mass balance model implies that the phosphorus supply from the sediments has not diminished since treatment began, and that further recovery of the lake will depend upon how long this feedback of phosphorus from the sediments continues. (Sims-ISWS)  
W80-03459

**EFFECTS OF LIMESTONE STRIP MINING ON BENTHIC MACROINVERTEBRATE COMMUNITIES,**  
Calgary Univ. (Alberta). Dept. of Biology.  
L. L. Osborne, R. W. Davies, and K. J. Linton.  
Water Research, Vol 13, No 12, p 1285-1290, 1979.

1 Fig, 4 Tab, 23 Ref, 1 Append.

Descriptors: \*Strip mines, \*Limestones, \*Water pollution effects, \*Invertebrates, \*Pennsylvania, Mine wastes, Mine acids, Alkalinity, Hydrogen ion concentration, Biota, Biological communities, Rivers, Sampling, Pollutants, Iron compounds, Water chemistry, Larvae, Biology, Buffering.

The changes in water quality and benthic macroinvertebrate community structure and composition related to limestone strip mining in western Pennsylvania were recorded and compared to the recorded effects of coal strip mining. In contrast to coal strip mining characterized by high total acidity and iron concentrations with decreased total alkalinity and pH, limestone strip mining showed only a slight increase in total acidity and bicarbonate alkalinity, and no increase in iron concentration due to the formation of heavy deposits of ferric hydroxide. The sulfate concentration and conductance increased with both coal and limestone strip mining. Limestone strip mining did not result in the extreme deterioration of benthic community structure and composition reported with coal strip mining. The decreased species diversity recorded was directly correlated with the sulfate concentrations and resulted from changes in species abundance rather than species composition. The changes in species abundance appear to be related to changes in food resource availability due to the deposition of ferric hydroxide on the detritus. (Sims-ISWS)  
W80-03460

**EFFECT OF SEDIMENT CONTROL DAMS ON THE WATER QUALITY OF A PRAIRIE LAKE,**  
South Dakota State Univ. Dept. of Biology.  
For primary bibliographic entry see Field 4D.  
W80-03477

**DRAINAGE AND LARVICIDING FOR CONTROL OF A MALARIA FOCUS IN HAITI,**  
World Health Organization, Washington, DC. Malaria Eradication Dept.  
For primary bibliographic entry see Field 4C.  
W80-03505

**IMPACTS OF COAL-FIRED POWER PLANTS ON FISH, WILDLIFE AND THEIR HABITATS,**  
Argonne National Lab., IL. Environmental Impact Studies.  
For primary bibliographic entry see Field 4C.  
W80-03518

**DISTRIBUTION, ABUNDANCE, AND PETROLEUM-DEGRADING POTENTIAL OF MARINE BACTERIA FROM MIDDLE ATLANTIC CONTINENTAL SHELF WATERS,**  
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Microbiology-Pathology.  
A. E. Maccubbin, and H. Kator.  
In: Proceedings of the Workshop: Microbial Degradation of Pollutants in Marine Environments, Pensacola Beach, Florida, 9-14 April 1978, U.S. Environmental Protection Agency, Miscellaneous Reports Series, No EPA-600/9-79-012, p 380-395, April 1979. 6 Fig, 8 Tab, 15 Ref.

Descriptors: \*Bacteria, \*Organic compounds, \*Oil pollution, \*Microbial degradation, \*Water pollution effects, Environmental effects, Seasonal, Baseline studies, Resources development, Oil spills, \*Outer Continental Shelf, Middle Atlantic, Crude oil.

Bacterial populations indigenous to surface (1 m) waters of the Middle Atlantic Continental Shelf were sampled at seasonal intervals to determine the abundance and distribution of petroleum-degrading (HC), chitinoclastic, and 'total' heterotrophic (HET) bacteria. Simultaneously, unweathered South Louisiana crude oil was added to aliquots of 1-m water samples to evaluate rates and patterns of saturated paraffin degradation on shipboard under controlled incubation conditions. Degradation was examined under selected nutrient and temperature regimes in both closed flasks and prototype 'open' or continuous dilution systems. HET bacterial

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levels generally decreased with distance from land. HC bacteria were most abundant in the coastal boundary layer. Changes in values of HC/HET tended to be directly related to the abundance of petroleum-degrading bacteria. Degradation of saturated paraffins in closed flasks characteristically resulted in removal of n-alkanes and isoprenoids at rates related to season, sampling location, and nutrient regime. (Sinha-OEIS)  
W80-03538

#### EFFECTS OF SUBLETHAL OIL CONCENTRATIONS ON THE COPEPOD, *NITOCRA AFFINIS*

North Carolina State Univ. at Raleigh.  
J. F. Ustach.  
Estuaries, Vol 2, No 4, p 273-276, December 1979.  
1 Tab, 30 Ref.

Descriptors: \*Oil pollution, \*Copepods, \*Water pollution effects, Oil spills, Environmental effects, Resources development, Baseline studies, \*Outer Continental Shelf, *Nitocra affinis*, Crude oil, Sublethal effects.

The water soluble fraction from 200 micro l Louisiana crude oil per liter of filtered sea water and of the one-half and three-quarter dilutions of the oil water with filtered sea water caused a reduction in brood size of the harpacticoid copepod, *Nitocra affinis*. The mean (or - standard error) brood size of the control was 14.41 or - 1.09 while those of the animals exposed to the undiluted, one-half, and three-quarter dilutions were 8.37 or - 1.78, 8.44 or - 1.25, and 8.35 or - 1.63, respectively. There were no statistically significant differences among the mean lengths of life spans or among the mean frequencies of broods produced. (Sinha-OEIS)  
W80-03540

#### ENZYME ACTIVITIES FOLLOWING CHRONIC EXPOSURE TO CRUDE OIL IN A SIMULATED ECOSYSTEM. I: AMERICAN OYSTERS AND BROWN SHRIMP

Mississippi State Univ., Mississippi State.  
J. E. Chambers, J. R. Heitz, F. M. McCorkle, and J. D. Yarbrough.  
Environmental Research, Vol 20, No 1, p 133-139, October 1979. 6 Tab, 10 Ref.

Descriptors: \*Oil pollution, \*Ecosystems, \*Oysters, \*Shrimp, \*Enzymes, Oil spills, Resources development, Water pollution effects, Environmental effects, Baseline studies, Seasonal, \*Outer Continental Shelf, *Crassostrea virginica*, *Penaeus* sp.

Enzyme activities were investigated in whole-body homogenates from oysters and hepatopancreas homogenates from shrimp which had been exposed to crude oil for 8 months in a simulated estuarine ecosystem. Enzymes assayed included acetylcholinesterase, alkaline phosphatase, Beta-glucuronidase, glutamic-pyruvic transaminase, lactic dehydrogenase, and malic dehydrogenase. Few seasonal trends in enzyme activity were observed in either species. Several alterations in enzyme activity were noted in oil-treated shrimp and oysters 6-8 months following the oil spill when the animals were stressed and may reflect physiological changes in animals which are severely stressed. However, few chronic alterations in enzyme activity were observed which could be attributed to the oil spill. (See also W80-03542) (Sinha-OEIS)  
W80-03541

#### ENZYME ACTIVITIES FOLLOWING CHRONIC EXPOSURE TO CRUDE OIL IN A SIMULATED ECOSYSTEM. II: STRIPED MULLET

Mississippi State Univ., Mississippi State.  
J. E. Chambers, J. R. Heitz, F. M. McCorkle, and J. D. Yarbrough.  
Environmental Research, Vol 20, No 1, p 140-147, October 1979. 5 Tab, 6 Ref.

Descriptors: \*Enzymes, \*Fish, \*Oil pollution, \*Water pollution effects, Estuaries, Ecosystems, Oil spills, Resources development, Baseline studies, Environmental effects, Seasonal, Gulf of Mexico, \*Outer Continental Shelf, *Mugil cephalus*.

Enzyme activities were investigated in brain, gill, liver, and muscle homogenates from striped mullet which had been exposed to crude oil for 10 months in a simulated estuarine ecosystem. Enzymes assayed included acetylcholinesterase, alkaline phosphatase, Beta-glucuronidase, glutamic-pyruvic transaminase, lactic dehydrogenase, and malic dehydrogenase. Few seasonal trends in enzyme activities were observed. Alterations in some enzyme activities, particularly acetylcholinesterase, Beta-glucuronidase, and malic dehydrogenase, may have reflected physiological changes in the mullet resulting from stress. In general, there were few chronic alterations in mullet enzyme activities resulting from the oil spill. (See also W80-03541) (Sinha-OEIS)  
W80-03542

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME VIII—APPENDIX G, FISH AND WILDLIFE RESOURCES

Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 6B.  
W80-03574

### 5D. Waste Treatment Processes

#### PROCESS FOR SOLUBLE CYANIDE REMOVAL FROM WASTEWATER STREAMS

Ciba-Geigy Corp., Ardsley, NY. (Assignee).  
Y. S. Sury, and M. J. Guillery, Jr.  
US Patent No 4,176,060, 4 p, 3 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1050, November 27, 1979.

Descriptors: \*Patents, \*Waste water treatment, \*Water pollution treatment, \*Industrial wastes, Chlorination, Acidity, Temperature, Chemical reactions, Cyanide.

The object of this invention is to provide a process for substantially destroying the soluble cyanide complex content of industrial wastewater streams. By conducting a hot acid chlorination technique, the soluble cyanide complex content of industrial wastewater streams can be reduced to a level below about 1 ppm. Thus, by contacting the wastewater at a temperature in excess of about 80°C, and preferably in excess of about 95°C, with sufficient mineral acid such as hydrochloric, sulfuric, nitric, phosphoric, and the like to provide a pH level below about 3.0 and with additional chlorine, rapid, efficient, complete reduction of the soluble cyanide complex is achieved. (Sinha-OEIS)  
W80-03362

#### A STUDY OF THE APPLICABILITY OF BATCH REACTOR WASHWATER TREATMENT FOR AREAS OF INTERMITTENT LOADING

Maryland Univ., College Park. Dept. of Civil Engineering.  
J. E. Alleman, and J. S. Colt.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-147507, Price codes: A04 in paper copy, A01 in microfiche.  
University of Maryland Water Resources Research Center Technical Report No 55, Nov 1979. 68 p, 36 Fig, 2 Tab, 10 Ref. OWRT A-049-MD (1), 14-34-0001-9022.

Descriptors: \*Sewage treatment, \*Waste water treatment, \*Batch waste water treatment, Aeration, Septic tanks, Waste treatment, Water treatment, Parks, Recreation facilities, Oxidation lagoons, On-site investigations, Discharge(Water), Influent streams, Inflow, Infiltration.

Seven waste water treatment facilities at Maryland state parks were examined and evaluated on the basis of system design, influent characteristics, and overall performance. Five of the plants are extended-aeration systems; one is a septic tank/filtration gallery; one is an oxidation pond with subsequent sand filtration. Unit capabilities ranged from 50,000-250,000 gallons per day; influent flows varied considerably in rate and strength. Influent depended primarily on plant location, park usage, and season of the year. All plants were operated

twelve months of the year and plant discharge during the winter was comprised of inflow and infiltration, and/or clean water used with chlorine injector units. Plants were shown to be vastly overdesigned, and hence there was an inadequacy of sufficient waste water organics necessary to maintain a desirable activated-sludge population. Dog food is added to several plants' influent stream to augment the lack of waste water organics. Batch treatment is recommended and two batch systems are proposed. Back-up low-flow systems are proposed for slow seasons. Connection of adjacent housing developments to existing park facilities is suggested. Consideration should be given to the renovation of plants, and their operation as intermittent discharge systems. (Schaefer-IPA)  
W80-03383

#### U.S. CORPORATE RESPONSE TO ENVIRONMENTAL OBJECTIVES

Environmental Protection Agency, Chicago, IL. Enforcement Div.  
For primary bibliographic entry see Field 6E.  
W80-03412

#### METHOD AND APPARATUS FOR RECOVERING LIQUID AND SOLID CONSTITUENTS OF WATER SOLUTIONS CONTAINING SPARINGLY SOLUBLE SOLIDS

Environmental Systems, Inc., El Paso, TX. (Assignee).  
R. T. Wheatley, and L. J. Kosarek.  
US Patent No 4,176,057, 10 p, 4 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1048, November 27, 1979.

Descriptors: \*Patents, \*Waste water treatment, \*Water purification, Industrial wastes, Separation techniques, Reverse osmosis, Chemical reactions, Suspended solids, Powerplants, Industrial plants, Product recovery, Closed loop system.

This invention relates to a method and apparatus for separating aqueous solutions containing sparingly soluble solids into useable constituents including the purifying of waste waters from industrial and power plants so that the plants may operate with a capability of a zero polluted effluent discharge and yet require only the disposal of a very small volume of sludge which in many instances may have a by-product value. Specifically, the invention provides a closed loop system for the recovery of water and solids from hydrometallurgical solutions, effluent of industrial and power plants and the like while the closed loop system only requires a low input of energy, utilizes reverse osmosis technology, chemically treats the brine effluent to reduce soluble constituents to prevent fouling of the reverse osmosis membrane, reintroduces the water content of the brine effluent back into the system for zero or minimal discharge of effluent and yields small easily handled volumes of substantially solid sludge which may have sufficient fertilizer or recoverable metal value to warrant processing. (Sinha-OEIS)  
W80-03414

#### WATER PURIFICATION METHOD AND APPARATUS

Westinghouse Electric Corp., Pittsburgh, PA. (Assignee).  
K. Moeglich.  
US Patent No 4,176,038, 12 p, 14 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1043, November 27, 1979.

Descriptors: \*Patents, \*Waste water treatment, \*Water pollution treatment, \*Electrolysis, Turbulence, Electrodes, Alternating current, Coagulation, Scaling, Equipment, Separation techniques, Fluidized bed.

An improved method and apparatus for continuously agglomerating solids of colloidal size or larger suspended in a liquid is disclosed. The process comprises passing the liquid between spaced electrode plates in the presence of a fluidized bed of conductive particles, and subjecting the liquid suspension to an electric field from alternating

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current applied across the electrodes through the conductive particles. The turbulence of the particles in the bed has been found to improve conductivity and current efficiency, minimize electrode erosion, and by a mechanical, scrubbing action of the bed particles, minimize fouling or scaling of the electrodes so that the suspending forces of the solids are rapidly and efficiently broken. The agglomerated solids may then be separated from the liquid by conventional means such as skimming, settling, flotation and the like. (Sinha-OEIS) W80-03426

**HYDROLOGIC DATA FROM A DEEP TEST WELL, CITY OF SARASOTA, FLORIDA,**  
Geological Survey, Tallahassee, FL. Water Resources Div.  
H. Sutcliffe, Jr.  
Available from OFSS U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Price codes: \$3.50 in paper copy, \$3.50 in microfiche. Geological Survey open-file report 79-1275, 1979. 23 p, 2 Fig, 5 Tab, 2 Ref.

Descriptors: \*Hydrologic data, \*Injection wells, \*Rotary drilling, \*Waste disposal, \*Liquid wastes, Test wells, Treatment facilities, Water analysis, Sampling, Chlorides, Aquifer characteristics, Water quality, Petrology, Chemical analysis, Trace elements, Florida, \*Sarasota(FL), Conventional circulation mud-rotary drilling method, Reverse circulation air-lift drilling method.

The city of Sarasota drilled a test well to a depth of 3,513 feet at the city's wastewater-treatment facility in downtown Sarasota, Fla. The test well was drilled to determine the feasibility of disposing of liquid waste from the city's secondary treatment plant. Drilling of the test well began in July 1973 and was completed in November 1974. A conventional circulation mud-rotary drilling method was used to a depth of 1,146 feet below land surface and a reverse circulation air-lift method was used to a depth of 3,513 feet. The greatest chloride concentration of water withdrawn from the test well was 31,000 milligrams per liter. The test well, uncased and open to dolomitic limestone between 2,006 and 3,513 feet, yielded 392 gallons per minute with a drawdown of approximately 100 feet. (Kosco-USGS) W80-03482

**PURIFICATION OF WASTE STREAMS CONTAINING AVAILABLE CHLORINE,**  
Olin Corp. New Haven, CT. (Assignee).  
W. J. Sakowski.  
U.S. Patent No 4,175,038, 4 p, 5 Ref; Official Gazette of the United States Patent Office, Vol 988, No 3, p 699, November 20, 1979.

Descriptors: \*Patents, \*Waste water treatment, \*Water pollution treatment, \*Chemical wastes, Chlorine, Chemical reactions, Chlorination, Temperature, Activated carbon.

A process is disclosed for reducing the available chlorine content of aqueous waste streams produced in chemical plants, especially calcium hypochlorite plants, in order to permit further purification treatment in waste purification systems which employ activated carbon. The available chlorine content is reduced by chlorinating the impure stream at a temperature in the range from about 80 to 100°C at a pH in the range from about 5.5 to about 8.5. In order to avoid excessive reactor boilover, close control of these conditions is required. In addition the reaction is time dependent and the holdup time in the reactor and a subsequent hold tank ranges from about 0.5 to about 4 hours. During this reaction the available chlorine forms the corresponding chlorate in the aqueous solution which may be passed through the activated carbon bed without adversely affecting the bed operation. (Sinha-OEIS) W80-03539

#### OXIDATION PROCESS,

Sterling Drug Inc., New York. (Assignee).  
L. A. Pradt, and W. B. Gitchel.  
U.S. Patent No 4,174,280, 4 p, 2 Fig, 7 Ref; Official

Gazette of the United States Patent Office, Vol 988, No 2, p 435, November 13, 1979.

Descriptors: \*Patents, \*Waste water treatment, \*Waste treatment, Industrial wastes, Oil pollution, Oxidation, Heat exchangers, Recycling, Explosives, Wet oxidation process, Product recovery, Petroleum products.

The invention comprises a process for oxidizing by wet air oxidation an oxidizable material which is insoluble, immiscible and difficult to suspend or emulsify in water. The process comprises injecting the material directly into a sealed reactor containing an aqueous medium supplied with an oxygen-containing gas, oxidizing the material at a temperature and pressure sufficient to provide controlled autogenic and self-sustaining reaction, to produce an oxidized effluent which is removed from the reactor. Materials especially adapted to oxidation by this process are petroleum products, motor oils, diesel fuel, explosives, and propellants. The invention can be employed in connection with any known application of wet air oxidation systems, including those designed for waste disposal, for byproduct or chemical recovery or for generation of useful energy. (Sinha-OEIS) W80-03591

**SLUDGE THICKENING APPARATUS AND PROCESS,**  
Envirotech Corp., Menlo Park, CA. (Assignee).  
E. M. Kelly.

U.S. Patent No 4,173,534, 8 p, 3 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 988, No 1, p 176-177, November 6, 1979.

Descriptors: \*Patents, \*Waste water treatment, \*Sewage treatment, \*Sludge treatment, Industrial wastes, Domestic wastes, Activated sludge, Anaerobic digestion, Equipment, Sludge thickening.

A wastewater treatment system of the activated sludge type includes a primary clarifier, a biological treatment unit and a secondary clarifier. The object of the invention is to provide means for concomitantly thickening primary and secondary sludge. In addition improved means are provided for inhibiting anaerobic decomposition of the primary sludge while it is being thickened. The apparatus comprises a tank having upper and lower feedwells. Primary sludge is introduced into the lower feedwell and flows into the lower part of the tank to thicken. Secondary sludge is aerated and introduced into the upper feedwell so that it flows from and thickens in the upper part of the tank by flotation type thickening. (Sinha-OEIS) W80-03596

### 5E. Ultimate Disposal Of Wastes

**PROCESSES AFFECTING THE FATE OF DREDGED MATERIAL,**

Army Engineer Waterways Experiment Station, Vicksburg, MS.  
B. W. Holliday.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A059 276. Price codes: A03 in paper copy, A01 in microfiche. Technical Report DS-78-2, August 1978. 32 p, 36 Ref.

Descriptors: \*Environmental effects, \*Waste disposal, Oceans, Estuaries, Rivers, Lakes, \*Dredged material, \*Dredged material disposal.

Determination of the fate of dredged material placed on the bottom of an ocean, lake, estuary, or river is an environmental concern that requires consideration and adequate prediction in the planning of a dredging project, since various natural processes can alter the initial configuration of the deposit and subject the surrounding bottom to some level of environmental impact. In the selection process for a disposal site, consideration must be given to the eventual disposition of dredged material in order that adequate determination of the site capacity can be made. The four primary environments that may contain subaqueous dredged material deposits are oceans, estuaries,

rivers, and lakes, with various energy-related zones within each environmental system. Each zone has a unique set of physical factors and sedimentological properties that will determine the potential fate of a dredged material deposit. Prediction of the fate of dredged material at a disposal site requires knowledge of: (1) currents, (2) waves, (3) tide, (4) suspended sediment concentrations, (5) seasonal energy fluctuations, (6) storms, (7) dredging/disposal operations, (8) shipping traffic, (9) fisheries activities, (10) bathymetry, (11) sedimentology, and (12) biological activity. (WES) W80-03396

**CONFINED DISPOSAL AREA EFFLUENT AND LEACHATE CONTROL (LABORATORY AND FIELD INVESTIGATIONS),**

University of Southern California, Los Angeles. And Army Engineer Waterways Experiment Station, Vicksburg, MS.  
K. Y. Chen, J. L. Mang, B. Eichenberger, and R. E. Hoeppel.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A062 882. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report DS-78-7, October 1978. 94 p, 5 Fig, 12 Tab, 9 Ref.

Descriptors: \*Effluents, \*Leachates, \*Waste disposal, Groundwater, Water pollution control, Dredging, Chemical analysis, Influent, \*Dredged material, \*Containment areas.

Summarizes findings of five work units concerned with impact of dredged material disposal in confined land disposal areas. Three work units dealt with active disposal operations at 11 sites; impact was assessed by comparing the quality of influents and effluents at each site with background surface receiving water. Two work units evaluated impact of confined disposal area leachates on groundwaters. Leachate studies included laboratory column elutions (3- to 9-month period) of each of five types of dredged material overlying one of two different soils; four field sites were also monitored for changes in leachate and groundwater quality in a 9-month study. Field sites included fresh and brackish water dredging environments in geographical areas where contamination problems were anticipated. Dredged material and environmental features varied greatly at different sites. In most cases soluble concentrations of most chemical constituents were very low. Only soluble manganese and ammonia nitrogen levels failed to meet most criteria. Leachate studies suggest the disposal of brackish water dredged material in upland disposal areas may render subsurface water unsuitable for public water supply or irrigation purposes. Guidelines for evaluation of potential disposal sites should be developed in steps not requiring complete execution of total program to determine site suitability. (WES) W80-03398

**HABITAT DEVELOPMENT FIELD INVESTIGATIONS, BUTTERMILK SOUND MARSH DEVELOPMENT SITE, ATLANTIC INTRACOASTAL WATERWAY, GEORGIA: APPENDIX A: PROPAGATION OF MARSH PLANTS AND POST-PROPAGATION MONITORING,**  
Georgia Univ., Brunswick. Marine Extension Service.

R. J. Reimold, M. A. Hardisky, and P. C. Adams.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A062 867. Technical Report D-78-26, July 1978. 1498 p, 48 Fig, 59 Tab, 121 Ref, 9 Append.

Descriptors: Marsh plants, \*Vegetation establishment, Waste disposal, Habitats, Dredging, Georgia, \*Dredged material, \*Habitat development, \*Atlantic Intracoastal Waterway, \*Buttermilk Sound(Georgia).

A field study to test the feasibility and impact of developing a marsh on dredged material was initiated in 1975 at Buttermilk Sound near the mouth of the Altamaha River, Glynn County, Georgia. The 2-ha island is in the Atlantic Intracoastal Waterway and is an area of dredged material disposal for maintenance dredging of the waterway. This

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report presents the results of habitat development activities between spring 1975 and fall 1977 and is Appendix A to the Buttermilk Sound marsh development site summary report. The site was graded to a 3.7 percent slope and partitioned into three elevation zones which were subjected to tidal inundation less than 6 hours each day, 6 to 18 hours each day, and more than 18 hours each day, respectively. Each zone was treated with a combination of experimental plantings including seven marsh plant species, two forms of propagule, and five patterns of fertilizer application. The plants were monitored for their response to fertilizer and inundation levels. Within the plots, interstitial water chemistry, soil chemistry, soil microbiology, and invading plant species were monitored. Aquatic biota and wildlife observations were made. (WES)

W80-03399

**HABITAT DEVELOPMENT FIELD INVESTIGATIONS, WINDMILL POINT MARSH DEVELOPMENT SITE, JAMES RIVER, VIRGINIA: APPENDIX F: ENVIRONMENTAL IMPACTS OF MARSH DEVELOPMENT WITH DREDGED MATERIAL: SEDIMENT AND WATER QUALITY.** Wright State Univ., Dayton, OH.; and Old Dominion Univ., Norfolk, VA. D. D. Adams, D. A. Darby, and R. J. Young. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A061 917. Price codes: A05 in paper copy, A01 in microfiche. US Army Engineer Waterways Experiment Station, Vicksburg, MS. Tech Rept D-77-23, Aug 78. Vol I: Characteristics of Channel Sediments Before Dredging and Effluent Quality During and Shortly After Marsh Habitat Development. 79 p, 6 Fig, 25 Tab, 70 Ref.

Descriptors: \*Environmental effects, \*Connate water, \*Habitats, Sediments, \*Dredging, Marshes, Water quality, Virginia, \*Habitat development, Dredged material, Waste disposal sites, \*Windmill Point(VA), James River(VA).

First of a two-volume appendix presenting the results of chemical and sedimentological studies conducted at a dredged material marsh development site located near Windmill Point, on the tidal freshwater James River, 16 km below Hopewell, Virginia. Navigation channel sediments were collected in January 1975, before dredging and marsh development, and described according to their temperature, pH, oxidation reduction potential, percent water, percent volatile solids, particle size composition, mineralogy, and cation exchange capacity. Sediment interstitial water and total sediment concentrations of sulfides and various nutrients and metals were also documented. The relationships between channel sediment characteristics and the chemical quality of effluent leaving the diked marsh development site were studied under three different conditions: (1) in January, 1975—during actual dredging and dredged material disposal for marsh substrate development, (2) during dewatering (2-4 days after the completion of dredged material disposal operations), and (3) in May 1975—3.5 months after dredging, before the marsh vegetation planting operations had begun or any extensive natural vegetation development had occurred. During dredging, about two-thirds of the channel sediments' organic material was lost, probably by flotation or as organic surface scums. Average concentration of suspended solids leaving the dike during dredging was 16 percent. (WES)

W80-03400

**HABITAT DEVELOPMENT FIELD INVESTIGATIONS, WINDMILL POINT MARSH DEVELOPMENT SITE, JAMES RIVER, VIRGINIA, APPENDIX E: ENVIRONMENTAL IMPACTS OF MARSH DEVELOPMENT WITH DREDGED MATERIAL: METALS AND CHLORINATED HYDROCARBON COMPOUNDS IN MARSH SOILS AND VASCULAR PLANT TISSUES.** Army Engineer Waterways Experiment Station, Vicksburg, MS. J. D. Lunz. Available from the National Technical Information

Service, Springfield, VA 22161 as AD-A062 170. Price codes: A04 in paper copy, A01 in microfiche. Technical Report D-77-23, August 1978. 88 p, 18 Fig, 10 Tab, 38 Ref.

Descriptors: \*Environmental effects, \*Dredging, \*Marshes, \*Chlorinated hydrocarbon pesticides, \*Metals, Dredged material, \*Habitat development, Vascular plants, Virginia, \*Windmill Point(VA), James River(VA).

Soil and vascular plant tissue samples were collected in October 1976 from three freshwater marshes located on the James River in Virginia. One marsh had been constructed using dredged material during 1974-75 maintenance dredging of the James River navigation channel. The other marshes were natural. The marshes studied had similar substrate characteristics. All were fine-textured silt and clay with volatile solids values between 10 and 20 percent, and contained about 50 percent water. Elevation and plant community characteristics were similar. Soil and plant tissue samples were analyzed for the metals nickel, zinc, chromium, lead, and cadmium and the chlorinated hydrocarbon compounds DDT, DDD, DDE, lindane, heptachlor, heptachlor epoxide, chlordane, endrin, dieldrin, Kelthane, Kepone, PCBs, and toxaphene. Marsh soil concentrations of chromium, cadmium, and lead were higher in the dredged material marsh; nickel and zinc concentrations were higher in the natural marsh. Low detectable levels of DDD, chlordane isomers, and Arochlor 1260 (PCB) occurred most frequently in dredged material marsh soils. Nickel was the only metal identified in experimental marsh plant tissue at higher levels than in similar tissue from a natural marsh. Potential soil chemical to plant transfer routes including surface sorption and adsorption and translocation were evidenced and discussed. (WES)

W80-03401

**HABITAT DEVELOPMENT FIELD INVESTIGATIONS, BOLIVAR PENINSULA, MARSH AND UPLAND HABITAT DEVELOPMENT SITE, GALVESTON BAY, TEXAS; SUMMARY REPORT.**

Army Engineer Waterways Experiment Station, Vicksburg, MS. H. H. Allen, E. J. Clairain, R. J. Diaz, A. W. Ford, and L. J. Hunt. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A066 224. Price codes: A07 in paper copy, A01 in microfiche. Technical Report D-78-15, August 1978. 73 p, 5 Tab, 36 Ref, 3 Appendix.

Descriptors: \*Habitats, \*Marshes, \*Environmental effects, \*Dredging, Vegetation, Vegetation establishment, Texas, \*Dredged material, \*Galveston Bay(TX).

A 2-1/2-year field investigation was conducted at Bolivar Peninsula, Galveston Bay, Texas, to test the feasibility and impact of developing marsh and upland habitats on dredged material. Baseline information derived before habitat development operations and results of postdevelopment operations are summarized. Two marsh grass species and nine upland plant species including trees, shrubs, and grasses were planted in test plots on a dredged material site lying between the Gulf Intracoastal Waterway and Galveston Bay. Tests were conducted to measure plant survival and performance in response to different fertilizer treatments and planting methods. Plantings of marsh grasses were made within an intertidal area protected from wave energies by sandbag dike. Prior to and during plant development, information was collected to document changes in fish and wildlife communities. Plantings were successful in both marsh and upland. Components of the habitat development site, consisting of planted vegetation and sandbag dike, attracted insects, aquatic organisms, and birds. After less than a year of development, the site provided heterogeneous habitats which tended to support greater use by fish and benthos than generally associated with sandy shores along Bolivar Peninsula. The study indicated habitat development is a feasible dredged material disposal alternative. (WES)

W80-03402

**EPA'S HAZARDOUS-WASTE PROGRAM: WILL IT SAVE OUR GROUND WATER.** G. Dallaire. Civil Engineering, Vol 48, No 12, p 39-45, December, 1978. 4 Fig.

Descriptors: \*Hazards, \*Waste disposal, \*Ground water, Regulations, Water pollution control, Landfills, Lagoons, Aquifers.

Case histories of ground water contamination by hazardous wastes are presented as examples of what the EPA hopes to prevent by imposing strict regulations on generators, transporters, storers, processors, and disposers of hazardous wastes. Once an aquifer is polluted it tends to remain polluted. The EPA's strategy is to keep hazardous materials out of aquifers by keeping track of them and ensuring that the final disposal site is insulated from the ground water. Landfills, lagoons and injection wells are the only means of disposal in many areas due to previous regulations barring incineration and surface water disposal. Weaknesses in the new EPA regulations include: ambiguity in defining hazardous wastes, overdesigning of waste disposal facilities, high retrofitting costs of landfills and lagoons, continuing contamination from abandoned landfills and lagoons, and lack of assurance that waste generators will comply with the regulations. (Purdin-NWVA)

W80-03431

**HYDROLOGIC DATA FROM A DEEP TEST WELL, CITY OF SARASOTA, FLORIDA.** Geological Survey, Tallahassee, FL. Water Resources Div. For primary bibliographic entry see Field 5D.

W80-03482

**TERMINAL ISLAND SEWAGE TREATMENT PLANT OUTFALL, LOS ANGELES HARBOR, CALIFORNIA; HYDRAULIC MODEL INVESTIGATION.** Army Engineer Waterways Experiment Station, Vicksburg, MS. W. H. McAnally, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A063 247. Price codes: A03 in paper copy, A01 in microfiche. Technical Report H-78-23, December 1978. 31 p, 2 Tab.

Descriptors: \*Sewage treatment, \*Outfall sewers, \*Treatment facilities, \*Hydraulic models, California, \*Los Angeles Harbor(Calif), \*Long Beach Harbor(Calif), \*Terminal Island(Calif).

Proposed relocations of the Terminal Island Treatment Plant outfall in Los Angeles Harbor were tested in a physical hydraulic model of Los Angeles and Long Beach Harbors, California. The model reproduced proposed plans of harbor modifications that included dredging and landfill in Los Angeles Harbor and dredging and construction of an oil loading pier in Long Beach Harbor. Five potential locations of the outfall were tested for conditions of a mean tidal range, a modeled effluent representing a prototype effluent of 10 ppt and 76F discharging into receiving water of 34 ppt and 60F. Model effluent was dyed red and photographed as it moved through the harbors. Outfall locations along the face of the proposed Los Angeles phase I landfill produced a plume that generally followed an eastward curving path toward the breakwater, passing out through Angel's Gate with ebb phase flows. During flood phase flows some dye moved back northward toward the outfall location. One location, near the western edge of the proposed landfill, showed an instability in direction of plume travel, moving westward at times. Tests of two locations were performed with a possible phase II landfill installed in the model. (WES)

W80-03560

**DISPOSAL OF DREDGED MATERIAL WITHIN THE NEW YORK DISTRICT: VOLUME I—PRESENT PRACTICES AND CANDIDATE ALTERNATIVES.** MITRE Corp., McLean, VA. METREK Div.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5E—Ultimate Disposal Of Wastes

For primary bibliographic entry see Field 5B.  
W80-03586

#### 5F. Water Treatment and Quality Alteration

**ALUMINA-LIME-SODA PILOT PLANT TESTING AT THE U.S. BUREAU OF RECLAMATION DESALTING TEST STATION AT YUMA, ARIZONA.**  
Midwest Research Inst. Kansas City, MO.  
A. D. Tippit, and J. W. Nebgen.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143688. Price codes: A05 in paper copy, A01 in microfiche. Final Report Prepared for Office of Water Research and Technology, 1979. 76 p, 10 Fig, 36 Tab, 3 Append, 14-34-0001-9509.

Descriptors: \*Silica, \*Desalination processes, \*Aluminum, \*Lime, \*Water treatment, Arizona, Reverse osmosis, Waste water treatment, Brines, Saline water, Brackish water, Pilot plants, Colorado River, Irrigation water, Cost analysis, Alumina-lime-soda process.

As a part of research being done at the Bureau of Reclamation's Yuma desalting plant, alumina-lime-soda, a specific process for silica removal from saline water in the pH range 8.5 to 9.0, was tested at Yuma, Arizona, in a 10,000 GPD pilot plant. Two types of water were used for the testing, one was chlorinated degreased Wellton-Mohawk Canal water which is brackish water pumped from irrigation fields to prevent salt buildup and the other was waste brine generated by several small reverse osmosis units. A flow diagram for the alumina-lime-soda treatment process is given along with start-up and shut-down procedures. The process involves treating water with sodium aluminate to provide alumina for removal of soluble constituents in raw water. The lime is used to maintain pH conditions for the reactions taking place. Test runs were performed by operating the plant for several days at a predetermined pH condition. Influent and effluent samples were composited hourly and daily and were analyzed for calcium, magnesium, sodium, chloride, sulfate, alkalinity, and silica. Results show that silica in the canal water can be reduced from 40mg/liter to 10mg/liter and the brine can be reduced from 60 to 70mg/liter to 10mg/liter. Cost analyses show canal water treatment to be \$0.48/1000 gal at a pH of 8.5 and brine treatment to be \$0.43/1000 gal at a pH of 8.5. For reverse osmosis desalination the maximum silica reduction occurs at the same point as minimum chemical cost. (Seigler-IPA)  
W80-03307

**WATER PURIFIER SYSTEM AND VALVE.**  
T. V. Tyler.  
U.S. Patent No 4,176,063, 17 p, 9 Fig, 19 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1051, November 27, 1979.

Descriptors: \*Patents, \*Water purification, \*Water treatment, Reverse osmosis, Membrane processes, Domestic water, Valves, Equipment, Water conservation.

An economical and commercially practical reverse-osmosis water purifier system has no back pressure acting against the semipermeable membrane, so that the filtering rate is maximized. Furthermore, the supply of tap water to the system is shut off automatically as soon as the pure water storage tank is full; use of water is greatly reduced. A single tube extends to the spigot from the pure water storage tank and contains a check valve which maintains pressure at the spigot when such storage tank is depressurized for maximized filtering speed. When the spigot is opened, the drop in water pressure in the tube opens a valve which passes squeeze water to the depressurized tank, whereupon it pressurizes to force pure water out the spigot. When the storage tank is full of pure water, a valve is closed automatically, thus preventing further flow of water to the drain so that water use is reduced. The opening of the spigot operates a pressure-responsive pilot valve which in

turn opens a squeeze-control valve. These valves, and also the check valve, and the valve which shuts down water flow when the storage tank is full of pure water, are economical, sensitive and rugged diaphragm valves. (Sinha-OEIS)  
W80-03310

**THE PLACING OF THE DISINFECTION STAGE IN A RECLAMATION PLANT TO REDUCE HALOFORM FORMATION.**  
Water Research Commission, Pretoria (South Africa).  
O. O. Hart.  
Water SA, Vol 5, No 4, p 178-188, October 1979. Presented at Symposium on 'Disinfection of Water', Pretoria, November 16, 1978. 12 Fig, 2 Tab, 45 Ref.

Descriptors: \*Chlorination, \*Halogens, \*Ozone, \*Disinfection, \*Water treatment, Chemical analysis, Gas chromatography, Adsorption, Bromides, Activated carbon, Public health, South Africa, Water sampling, Reclamation, Potable water.

Four chlorination process configurations were investigated at the Stander Water Reclamation Plant in Pretoria, South Africa, to identify the process that would produce the least concentration of volatile halogenated hydrocarbons (VHH). Chlorination of water supplies may produce halogenated compounds that could be carcinogenic. A flow-chart is presented for the four process configurations. For each process tested 24 hour representative samples were collected after the 8th day of process operation. A Hewlett Packard 5710A gas chromatograph with an auto-sampler was used for quantitative analyses. Results show that the configuration process producing the lowest VHH concentrations for this particular plant is breakpoint chlorination followed by two-stage active carbon adsorption. It was also shown that: activated carbon is effective in removing VHH if at least 30 minutes of contact time is allowed; the higher the bromide concentration in the water, the higher the VHH yield; and the mole ratio of bromide to total organic carbon can indicate the ultimate VHH concentration to be expected. Various pros and cons of chlorine disinfection and ozone disinfection were also examined. (Seigler-IPA)  
W80-03324

**THE SIGNIFICANCE OF THE ROOT MEAN SQUARE VELOCITY GRADIENT AND ITS CALCULATION IN DEVICES FOR WATER TREATMENT.**  
Separa (PTY) LTD, Johannesburg, (South Africa).  
P. Polasek.  
Water S.A., Vol 5, No 4, p 196-207, October 1979. 11 Fig, 1 Tab, 14 Ref.

Descriptors: \*Water treatment, \*Hydrodynamics, \*Mixing, \*Hydraulic systems, \*Fluid mechanics, Hydraulic models, Physics, Energy gradient, Velocity, Head loss, Flow around objects, Resistance, Kinetics.

Various types of hydraulic and mechanical agitators used in chemical water treatment processes are reviewed in terms of their root mean square velocity gradients. The rate of aggregation of destabilized particles in the water is dependent on the movement of the particles which is effected by the agitation of the water. The intensity of agitation in a system (rapid mixing, rapid agitation, or slow agitation) can be expressed by the instantaneous velocity gradient  $G$  in a flow. However, because the value of  $G$  varies throughout an agitation system and is difficult to calculate, the root mean square velocity gradient can be substituted. Types of hydraulic (gravitational) agitation systems reviewed are flash mixers, baffled mixers (perforated and slot), orifice mixers, and ring water jump mixers. Baffled channels and sludge blankets are agitation arrangements discussed for the hydraulic agitators. Mechanical agitators reviewed are flash mixers with three agitation arrangements, revolving agitators, and reciprocating agitators. Hydraulic or gravitational agitators are recommended for use only when the nominal flow design can be maintained at all times with no great variation in raw water quality or temperature. The Euler crite-

rion of hydrodynamic similarity was found to be an accurate means of calculation of the useful power input of mechanical agitation. (Seigler-IPA)  
W80-03326

**APPARATUS AND METHOD FOR TREATMENT OF FLUID WITH OZONE.**  
K. Stopka.  
U.S. Patent No 4,176,061, 9 p, 7 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1050, November 27, 1979.

Descriptors: \*Patents, \*Water purification, \*Water treatment, Water pollution treatment, Aeration, Ozone, Bubbles, Domestic water, Potable water, Equipment.

The invention relates to a method of and an apparatus for purifying drinking water. The apparatus comprises of an ozonator for providing a gas containing ozone and an aspirator which mixes the gas with water to provide an ozone and water mixture having microbubbles of gas. The mixture is then circulated through an elongated treatment conduit having a length of between about 20 to 40 feet and a diameter less than 1 inch to allow the gaseous ozone to dissolve in the water. Throughout the length of the conduit the ozone oxidizes impurities in the water and provides water having a relatively high purity. The ozonator used to provide ozone is capable of providing a gas having at least 1.2 weight percent ozone, preferably a gas having an ozone concentrations approaching 2 weight percent. The ozonator is comprised of electrodes connected in series by gas flow lines. (Sinha-OEIS)  
W80-03332

**RESIN TREATMENT IMPROVES HIGH-COLOR GROUND WATER.**  
Fuhrberg Waterworks, Hannover (Germany, F.R.).  
W. Kolbe.  
Water & Sewage Works, Vol 126, No 1, p 68-69, January, 1979. 5 Fig.

Descriptors: \*Anion exchange, \*Water treatment, \*Humic acids, \*Resins, Turbidity, Organic wastes, Filtration, Aerobic bacteria, Chlorination, Ground water.

The treatment of turbid ground water using strong basic anion exchange discussed. The water treated contained iron, manganese, humic acids, and sulfate. About 1,347,000 gallons can be filtered through 36 cubic feet of resin before the next regeneration becomes necessary. The resin is regenerated with a sodium chloride and sodium hydroxide solution which can be used several times. Removals of organics do not significantly increase with decreasing filter velocity. The resin significantly reduces bacterial growth in the drinking water and, correspondingly, chlorine consumption. (Purdin-NWWA)  
W80-03436

**PRODUCTION OF HALOFORM PRECURSORS BY WATER PIPE BACTERIAL FILMS.**  
Missouri Univ.-Rolla. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5A.  
W80-03478

#### 5G. Water Quality Control

**PERSPECTIVES FROM THREE YEARS EXPERIENCE OF REGIONAL WATER SERVICES IN THAMES WATER AUTHORITY.**  
Thames Water Authority, London (England).  
P. Black, and A. Morrison.  
Water Resources Bulletin, Vol 15, No 6, p 1578-1588, December 1979. 7 Ref.

Descriptors: \*Water management (Applied), \*Administration, \*Watershed management, Water supply, Drainage, Rivers, Watersheds (Basins), Sewage, Sewage treatment, Sewage effluents, Sewage disposal, Pollutants, Water pollution, Water quality, Droughts, Regulation, Water re-

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sources, \*England, \*Water authorities, \*Thames River(England).

Thames Water is one of ten Regional Water Authorities established in 1974 to manage all water services in England and Wales. This paper looked back at water reorganization and reviewed the achievements and highlights of the past three years. Constitutionally, Water Authorities are a combination of a nationalized industry and local authority. This has advantages and disadvantages. Freedom of action, particularly in financial matters, is constrained by government and official agencies. A severe pollution of the upper Thames and the drought of 1976 tested Thames Water's ability to deal with emergencies. Thames Water does not have an operational monopoly. Private water companies supply one third of the water demand, and local authorities manage nearly all the sewers. But Thames Water's control over planning and investment ensures that the river basin is managed in a coordinated fashion. Tariff structure changes have led the Authority to bill all its consumers direct. The Thames is a small but intensively used river, and vigilance is needed to maintain water quality. Thames Water is proud of the restoration of the tidal Thames from a typical grossly polluted metropolitan estuary to its present excellent condition. The British government intends to establish a national water industry strategic planning organization, but at the same time they affirm that there can be no departure from the principle of integrated river basin management. (Sims-ISWS) W80-03364

**CONFINED DISPOSAL AREA EFFLUENT AND LEACHATE CONTROL (LABORATORY AND FIELD INVESTIGATIONS),** University of Southern California, Los Angeles, and Army Engineer Waterways Experiment Station, Vicksburg, MS. For primary bibliographic entry see Field 5E. W80-03398

**WATER QUALITY COMMITTEE (ANNUAL REPORT),** American Bar Association, Washington, DC. Natural Resources Lawyer, Vol 12, No 1, p 273-310, 1979.

Descriptors: \*Water quality, \*Effluents, \*Water quality standards, Legislation, Oil spills, Administrative decisions, Judicial decisions, Toxins, Pollution, Water quality control.

In 1978, developments in the water quality field caused a shift in the focus of Clean Water Act (CWA) litigation. From the effluent guidelines, the controversy shifted to questions involving deadline extensions, effluent standards for toxic pollutants, and enforcement of the National Pollutant Discharge Elimination System (NPDES). A district court decision invalidated federal Environmental Protection Agency (EPA) regulations governing hazardous substances. Hasty legislation was implemented in an attempt to revive the EPA's program governing hazardous substances. The EPA published effluent guidelines and standards of performance for additional industrial categories. EPA programs to establish 'best available technology' effluent limitations for toxic pollutants were continued throughout the year. The EPA also began to implement the 1977 amendments of the CWA. Also adopted or proposed were comprehensive amendments to its regulations governing grants, water quality planning and management, and the NPDES program. These actions and other highlights of the 1978 CWA developments are explored. Legislative activity, judicial decisions, and administrative actions are reviewed in detail. (Quarles-Florida) W80-03405

**ANTI-CORROSION COMPOSITION FOR USE IN AQUEOUS SYSTEMS,** Quatic Chemicals Ltd., Guelph (Ontario). (Assignee): F. Suzuki. U.S. Patent No 4,176,059, 7 p, 2 Tab, 10 Ref; Official Gazette of the United States Patent Office,

Vol 988, No 4, p 1049-1050, November 27, 1979.

Descriptors: \*Patents, \*Water treatment, \*Water quality control, Industrial water, Scaling, Corrosion, Cooling water, Chemical reactions, Heat exchangers, Recirculating water.

A low toxicity, corrosion and scale inhibiting composition for use in recirculating aqueous systems, e.g. in heat exchangers, comprises from about 3-1,000 parts by weight of molybdate, from about 0.5-1,000 parts by weight of an organic cationic or non-ionic surfactant, from about 0.3-1,000 parts by weight of a water soluble polyphosphate and from about 0.05-500 parts by weight of an azole, for example tolyltriazole. The composition is water soluble or water dispersible, and is effective in very small amounts (3-3,500 ppm) for corrosion control of metals such as carbon steel, copper and aluminum exposed to circulating water. (Sinha-OEIS) W80-03409

**METHOD MEANS FOR DE-SILTING WATER,** J. J. Grobler. U.S. Patent No 4,176,058, 10 p, 8 Fig, 2 Tab, 7 Ref; Official Gazette of the United States Patent Office, Vol 988, No 4, p 1049, November 27, 1979.

Descriptors: \*Patents, \*Water purification, \*Water treatment, \*Reservoir silting, Suspended solids, Silts, Sediment control, Floating, Bubbles, Aeration, Agglomeration, Silt recovery.

The invention relates to a method and a means for desilting water. The settling of silt in inland lakes and dams considerably reduce the effective life span of such lakes and dams, and also cause a substantial loss of fertility of the agricultural lands from which the silt originates. The invention provides a method for removing silt particles from water by first agglomerating the silt particles into larger size particles, imparting hydrophobic properties to the larger size particles and floating them to the surface, and removing the floated matter. The invention also provides an apparatus for removing silt particles from water which includes means for feeding into and mixing with the water chemicals selected for agglomerating the silt particles and converting them into larger size hydrophobic particles, means for bubbling air through the water to float the larger size particles to the surface, and means for removing the floated matter. (Sinha-OEIS) W80-03410

**EXECUTIVE SUMMARY OF THE REPORT 'SURFACE IMPOUNDMENTS AND THE EFFECTS OF GROUND WATER QUALITY IN THE UNITED STATES—A PRELIMINARY SURVEY',** Geraghty and Miller, Inc., Tampa, FL. For primary bibliographic entry see Field 5B. W80-03424

**EPA'S HAZARDOUS-WASTE PROGRAM: WILL IT SAVE OUR GROUND WATER,** For primary bibliographic entry see Field 5E. W80-03431

**USE OF ENVIRONMENTAL DATA IN ASSESSING THE QUALITY OF IRRIGATION WATER,** Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology. A. Cass. Soil Science, Vol 129, No 1, p 45-53, January 1980. 2 Fig, 3 Tab, 21 Ref.

Descriptors: \*Irrigation water, \*Water quality, \*Data collections, \*Model studies, \*Africa, Rivers, Irrigation practices, Management, Salinity, Sampling, Rainfall, Evapotranspiration, Soil water, Drainage, Soils, Salt tolerance, \*Natal(South Africa), Sodium adsorption ratio, Environmental model.

The quality of irrigation water of selected rivers in Natal is characterized in terms of chemical components related to salinity and sodicity. Using rainfall and evapotranspiration data for each sampling site,

and assuming certain management practices, the authors calculated the anticipated soil water salinity and sodicity values for poorly drained soils, obtaining four variables to assess water quality: water salinity and sodicity and soil salinity and sodicity. Grouping the data according to crop salt tolerance and soil sodicity limitations confirms the evaluation of water quality obtained using recently published schemes for assessing irrigation water. The general agreement between schemes for classifying irrigation water indicates the feasibility of using a system of evaluation of water quality based on crop, soil, and climatic characteristics of the area under consideration. Comparing the saturation extract salinity and sodicity of poorly drained soils with salinity and sodicity calculated from this environmental model showed reasonably good agreement, which did not invalidate the general qualitative usefulness of this approach. (Visocky-ISWS) W80-03471

**PROXIMITY OF AGRICULTURAL AREAS TO MAJOR AQUIFERS IN CONNECTICUT,** Geological Survey, Hartford, CT. Water Resources Div. For primary bibliographic entry see Field 7C. W80-03480

**CENTRIFUGAL WATER OIL SEPARATOR,** Continental Oil Co., Ponca City, OK. (Assignee). J. K. Sammons, and C. H. Fox, Jr. U.S. Patent No 4,175,040, 6 p, 4 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 988, No 3, p 699-700, November 20, 1979.

Descriptors: \*Patents, \*Water pollution control, Water quality control, Separation techniques, Oil pollution, Centrifugation, Equipment, Oil recovery.

A simple, efficient apparatus for reducing the oil content of water recovered from production means and withdrawn from contaminated areas to levels environmentally acceptable is described. A centrifugal oil-water separator comprises an inner spinning bowl having openings near the lower outer periphery for passage of water into an outer bowl which remains stationary. The oil-water mixture is passed to the upper center of the spinning bowl where the oil and water separate. The oil concentrates near the top of the inner bowl. Disposable water is removed from the outer bowl and the oil is recovered from a trough adjacent the top of the spinning inner bowl. (Sinha-OEIS) W80-03522

**WASHER/SEPARATOR SYSTEM FOR DRILLING CUTTINGS IN WATER ENVIRONMENT OIL WELLS,** J. D. Fisher. U.S. Patent No 4,175,039, 8 p, 4 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 988, No 3, p 699, November 20, 1979.

Descriptors: \*Patents, \*Water pollution control, \*Water quality control, \*Oil pollution, Separation techniques, Drilling, Drilling fluids, Equipment, Offshore oil wells, Well cuttings.

A method and apparatus for disposing of cuttings intermingled with fluids, such as oil, which are considered pollutants in water, from a well being drilled in a water environment offshore is described. A receiving tank with an agitation sub-chamber causes thorough scrubbing of the deposited drilling cuttings. The wash cuttings settle to the bottom of the tank causing the solution level to rise. When a predetermined solution level is reached, an auger, situated at the bottom of the tank, is activated and the collected cuttings are removed. When the solution level drops a sufficient amount for the removal of the cuttings, the auger is shut off and the cycle begins anew. Fresh water washing solution may be used, so that the oil saturated depleted solution may be added to the drilling mud. Collected cuttings may be deposited in the ocean without a slick forming. (Sinha-OEIS) W80-03530

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME V-APPENDIX D, WATER SUPPLY AND WATER POLLUTION CONTROL

Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 273. Price codes: A99 in paper copy, A01 in microfiche. Prepared by the Federal Water Pollution Control Administration for the Ohio River Basin Coordinating Committee, June 1967. 804 p, 25 Fig, 293 Tab, 13 Append.

Descriptors: \*Water resources development, \*Ohio River Basin, Water supply, \*Water pollution, \*Water quality, \*Economic prediction, \*Population, \*Multiple purpose projects, \*Water quality control, Planning, Industry, Water demand, Acid mine wastes, Waste load, Pollutants, Stream pollution.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly for that portion within Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin. This Appendix presents water supply and water pollution control data both for the region as a whole and for each of 13 subbasin areas. The objectives are to determine overall requirements for municipal and industrial water supply and water quality control and to give general appraisals of measures required to meet the indicated needs. The report includes a description of the Basin, its economy, requirements for municipal and industrial water supply, and water quality control needs and problems. The methodological framework consisted of two distinct parts: an input-output econometric model to generate projections for population and economic activity, and an allocation procedure to distribute shares of the Basin projection to the subareas of the Basin. Projected increases in municipal and industrial water supply vary greatly among subbasins. Major water quality control problems include projected waste load increase, acid mine drainage, and heat pollution. Thirteen specific recommendations are made, including secondary treatment for municipal and industrial wastes, designing new sewerage facilities to prevent the necessity of by-passing untreated wastes, storage for streamflow regulation to enable increasing streamflow and waste assimilation during low flow periods, detailed investigations of costs of alternative treatment methods, a program for correcting acid mine drainage, and off-stream cooling methods. Detailed reports are included for the 13 sub-basin areas. (Arnold-NC)  
W80-03577

#### LIQUID TREATMENT APPARATUS,

Ecodyne Corp., Lincolnshire, IL. (Assignee).  
D. J. Butterworth.

U.S. Patent No. 4,174,282, 7 p, 5 Fig, 12 Ref; Official Gazette of the United States Patent Office, Vol 988, No 2, p 436, November 13, 1979.

Descriptors: \*Patents, \*Water treatment, \*Water quality control, \*Filtration, Industrial water, Nuclear powerplants, Filters, Ultra-filtration.

Liquid filters that produce the ultra pure water required from steam generation of electricity are commonly precoated with diatomaceous earth or powdered ion exchange resins. Such filters may have five hundred or more individual filter elements that are each over six feet in length. Full utilization of the liquid treating capacity of the precoat materials requires that the precoat be uniformly applied over the full length of each filter element. When the steam used for electric power generation comes from a nuclear reactor, the filtering apparatus becomes highly radioactive, and the individual filter elements must be capable of being installed and removed from a remote location. During prolonged usage, the dimensions of the individual filter elements may change, as for example when a wound nylon filter elements shrinks during high temperature service. Accordingly, it is an object of this invention to provide an improved liquid treatment apparatus that will fulfill the above requirements. (Sinha-OEIS)

W80-03585

#### FLOATING-TYPE ANTI-OIL, ANTI-IMPACT AND ANTI-WAVE BARRIER,

Mitsubishi Jukogyo Kabushiki Kaisha, Tokyo (Japan). (Assignee).  
N. Toki.

U.S. Patent No. 4,174,185, 7 p, 11 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 988, No 2, p 403, November 13, 1979.

Descriptors: \*Patents, \*Barriers, \*Oil pollution, \*Pollution abatement, Water quality control, Waves(Water), Floating, Check structures, Protection, Marine structures.

A floating-type anti-oil, anti-impact and anti-wave barrier includes means for intercepting a flow of oil floating on the water and diverting the oil in directions at right angles to the original direction of flow, means for mitigating an impact force exerted by a ship or the like, and means for intercepting waves. The barrier comprises a first float formed by serially arranging at regular intervals elongated boxes in their longitudinal direction. A second float is formed exactly in the same manner as the first float and placed parallel to the first float at staggered positions relative to each other. Floatable spaces having shock-absorbing and intercepting functions are placed between the side surfaces of the floating boxes. Chains or ropes moor the respective floating boxes to each other. The barrier can be utilized as a permanently installed anti-oil and anti-impact waterbreak for a marine oil storage tank, a marine plant, marine air-port, etc. (Sinha-OEIS)  
W80-03593

## 6. WATER RESOURCES PLANNING

### 6A. Techniques Of Planning

#### RESERVOIR STORAGE DETERMINATION BY COMPUTER SIMULATION OF FLOOD CONTROL AND CONSERVATION SYSTEMS,

Hydrologic Engineering Center, Davis, CA.  
B. S. Eichert.

Technical Paper No 66, October 1979. 8 p, 8 Ref.

Descriptors: \*Flood control, \*Model studies, \*Planning, \*Computer models, Systems analysis, Reservoir operation, Reservoir storage, Water supply, Water storage, Multiple-purpose reservoirs, Hydroelectric power, Water conservation, HEC-5.

This paper presented ways that a comprehensive simulation computer program can be used in planning a water resources system composed primarily of multipurpose reservoirs with flood control as a major project purpose. The computer program HEC-5, Simulation of Flood Control and Conservation Systems, was used to illustrate the ways in which a generalized computer program can be applied to a wide variety of reservoir systems. The HEC-5 model can be used in almost any reservoir system regardless of location, project purposes, and physical conditions in the basin by specifying as input data such items as the configuration of the reservoirs in the basin, the project purposes, streamflow data, channel routing criteria, evaporation data, etc. (Humphreys-ISWS)  
W80-03348

#### OPERATIONAL SIMULATION OF A RESERVOIR SYSTEM WITH PUMPED STORAGE,

Corps of Engineers, Savannah, GA.

G. F. McMahon, V. R. Bonner, and B. S. Eichert. Hydrologic Engineering Center, Davis, California. Technical Paper No 60, February 1979. 30 p, 3 Fig, 6 Tab, 9 Ref, 2 Append.

Descriptors: \*Reservoir operation, \*Pumped storage, \*River systems, \*Systems analysis, \*Georgia, Model studies, Multiple-purpose reservoirs, Reservoirs, Hydroelectric plants, Management, Computer models, Evaporation, Electric power, \*Savannah River(GA).

This paper described an operational simulation used to evaluate the effects of the addition of pumped storage on hydropower production and recreation usability of a reservoir system. The operational simulation was in support of a study to determine the feasibility of installing pump-turbines at the Richard B. Russell Dam and Lake project, presently under construction and currently authorized for conventional hydropower, flood control, and recreation. The pumped-storage feasibility study addressed the recreational, environmental, hydropower, water supply, and economic impacts of pumped storage and conventional hydropower production at Russell on Corps of Engineer's dams on the Savannah River. The simulation results yielded evidence that system operation is more efficient than operation for at-site requirements, producing less dump energy, pumping energy, and primary energy shortages. In addition, system operation was simulated to reduce pool fluctuations and achieve a better balance of reservoir storage levels than operation with at-site requirements. It can be noted from data presented that the ratio of primary energy shortage to system demand with pumped storage is approximately 10% smaller than for system operation without pumped storage. This indicates that the addition of pumped storage could provide somewhat greater flexibility in meeting system requirements. (Humphreys-ISWS)  
W80-03351

#### SIZING FLOOD CONTROL RESERVOIR SYSTEMS BY SYSTEMS ANALYSIS,

Hydrologic Engineering Center, Davis, CA.

B. S. Eichert, and D. W. Davis.

Technical Paper No 44, March 1976. 32 p, 1 Fig, 3 Tab, 4 Ref.

Descriptors: \*Flood control, \*Systems analysis, \*Reservoirs, \*Optimization, \*Project planning, Model studies, Flood damage, River systems, Economics, Management, Planning, Hydrology, Annual benefits, Reservoir operation.

This paper discussed the scope of reservoir system formulation, modeling flood control systems, criteria and strategies for system formulation, and illustrated the concepts with applications in recent systems studies. The systems viewpoint applied to reservoir flood control systems includes the physical representation of the system (sites, storage, costs, stream conveyance, basin hydrology) and the economic representation of the consequences of flooding (damage centers, damage potential, frequency of flooding). The flood control system to be formulated consists of the reservoirs and their operating characteristics. Computer Program HEC-5C, 'Simulation of Flood Control and Conservation Systems,' has been developed by The Hydrologic Engineering Center as a generalized tool which can be used to simulate any flood control system. The program was written to be compatible with generally accepted analysis procedures that require data normally developed in the course of studying flood control reservoirs. (Humphreys-ISWS)  
W80-03353

#### THE MANAGEMENT OF GROUND WATER SUPPLIES,

Ground Water Consultants Group, Edmonton (Alberta).

For primary bibliographic entry see Field 4B.

W80-03435

#### APPLICATION OF OPERATIONS RESEARCH TECHNIQUES FOR A PROBLEM IN WATER RESOURCES MANAGEMENT: ECONOMIC APPRAISAL OF CHANGES IN WATER USE INDUCED BY INVESTMENTS INTO NAVIGABLE RIVERS AND CANALS,

Eidgenossische Technische Hochschule, Zurich (Switzerland). Inst. of Operations Research.

K. Hazeghi, W. Schmid, and P. Petalas.

In: Modeling, Identification and Control in Environmental Systems, p 977-988, North-Holland, Publishing Company, 1978. 3 Fig.

Descriptors: \*Operations research, \*Model studies, \*Economic impact, \*Water supply, \*Navigable

## Techniques Of Planning—Group 6A

ivers, Simulation analysis, Systems analysis, Cost-benefit analysis, Water allocation(Policy), Mathematical models, Economic efficiency, Water resources development, West Germany, Economic justification, Regional economics, Investment, Weirs, Canals, Engineering structures, Canals, Water utilization, Management.

A computer model was developed to determine net benefits accruing to urban, industrial and agricultural water users from construction of weirs and canals built for navigation purposes in West German river systems. The model, simulating a 1-yr period, analyzes costs of the most preferable alternative water supply and discharge (S/D) system. Economic effects are posited in physical terms accruing to water users by comparison of the channel-reservoir system under simulated conditions with and without the weirs and canals, as affecting supply of water, water quality and discharge capacity as well as utilization by water users for withdrawal and discharge purposes. Alternative costs in the model are those of the optimal water supply and discharge system needed under assumption of no construction of the canals and weirs, that will satisfy all user requirements if the construction were to take place. The model treats the S/D system in three interacting networks: an X network for water supply only, a Y network for water discharge only and a Z network performing both functions simultaneously, as well as that of water treatment plants. Criteria for benefits with alternate S/D systems are annual costs, the sum of yearly operation costs and the annuity of investment costs. Mathematica formulation of the problem, i.e., determination of the most economical alternate S/D system, leads to an optimization problem with partly linear and partly nonlinear constraints and nonlinear objective functions. (Harris-Wisconsin) W80-03501

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME III—APPENDIX B, PROJECTIVE ECONOMIC STUDY.

Army Engineer Div. Ohio River, Cincinnati. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 271. Price codes: A99 in paper copy, A01 in microfiche. Prepared for the Ohio River Basin Coordinating Committee by Arthur D. Little, Inc., August 1964. 436 p, 7 Fig, 87 Tab, 12 Append.

Descriptors: \*Water resources, \*Water resources development, \*Economic prediction, \*Capital, \*Planning, \*Models, \*Forecasting, \*Ohio River Basin, \*Employment, \*Industrial production, \*Economics, \*Economics, Labor supply, Population, Methodology, Electric power, Regional development, Resources, Linear programming, Water policy.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly within Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin through water resource development. This Appendix presents the base economic data and projections for the area, the methodological framework used in the study, and a report on implementation of the projection model. The methodological framework consisted of an econometric forecasting model used to derive economic activity projections in the Basin as a whole, and an allocation procedure used to distribute projected output and employment estimates among the 19 subareas of the Basin. The purpose of the model was to project levels of industrial and government activity, income and employment to 1980 and 2010. The future labor supply was projected on the basis of population trends. Population projections were made using the component or cohort-survival method. The major procedures required to implement the projection model are outlined. The operational process was divided into three phases: (1) demographic projections of population and labor force; (2) derivation of base year values, projection parameters, and demand projections; and (3) reconciliation of results of the demographic projection with those of the demand pro-

jections. Detailed descriptions of the procedures are provided in the appendices. (Arnold-NC) W80-03579

#### AN URBAN RUNOFF MODEL FOR TULSA, OKLAHOMA.

Texas Univ. at Austin. Center for Research in Water Resources. L. R. Beard, and S. Chang. August 1978. 209 p, 6 Fig, 19 Tab, 63 Ref, 4 Append.

Descriptors: \*Rainfall-runoff relationships, \*Streamflow forecasting, \*Model studies, \*Streamflow, \*Linear programming, \*Models, \*Mathematical models, Tulsa(OK), Mingo Creek(OK), Haikay Creek(OK), Loss-rate functions, Drainage, Rational formula, Regression analysis, Hydrograph analysis, Unit hydrographs, Urbanization, Impervious surfaces.

The purpose of this study was to develop a method to adjust flood flows for effects of urbanization in the Tulsa (OK) area. As no Tulsa runoff data were available, data for similar areas were used in model development. Adjustment of flood flows to account for urbanization was accomplished by applying a rainfall-runoff model to representative storms and adjusting the parameters to reflect the various effects of urbanization. A literature survey was undertaken to assess available information on all existing hydrologic models. Twenty-five models were reviewed, of which only 7 were considered suitable for this application. The model finally chosen was the Flood Hydrograph Package of the Hydrologic Engineering Center (HEC-1). The package was used to derive model coefficients for each of the 114 floods studied. The general model was found to be highly flexible. Initial full-model and restricted-model calibrations were undertaken, and special calibrations were undertaken for treatment of impervious areas. The Clark unit-hydrograph parameter and loss parameter were separately related to drainage basin parameters by use of multiple linear regression. This procedure appears to produce excellent results in reproducing observed flood hydrographs from recorded rainfall. Applications of the model were made for Mingo and Haikay Creeks to compute runoff from the 1976 storm in the area. Data used in this study provide no evidence that urbanization appreciably affects runoff concentration times in the absence of channel improvements. About 40% of the impervious area appears effective in increasing volume of runoff. It is believed that the procedures used in the study are highly satisfactory for evaluating changes in runoff rates due to urbanization. (Arnold-NC) W80-03582

#### AN APPROACH TO THE CONSTRUCTION OF THE REGIONAL WATER RESOURCE MODEL.

International Inst. for Applied Systems Analysis, Laxenburg (Austria). M. Albegow, and V. Chernyatin. Research Memorandum RM-78-59, November 1978. 38 p, 9 Fig, 8 Ref.

Descriptors: \*Models, \*Water resources, \*Bulgaria, \*Mathematical models, \*Regional analysis, \*Modeling systems, \*Water quality, \*Water management(Applied), \*Regional development, Water resources planning, Model studies, Danube River, Analytical techniques, Water demand, Water supply, Water quality, Reservoirs, Irrigation, Water costs, Economics, Unit costs, Annual costs, \*Silistra region(Bulgaria).

The authors attempt to define a special regional water resource model as part of a more general system of regional models. This model system embraces a multi-stage solution approach to regional problems, examining settlements and pollution; labor and capital; and the location of industry, agriculture, and public services as factors in the determination of water supply needs. The principal system approach simultaneously analyzes water supply costs of all subregions of a selected study area, using data such as average water cost per cubic meter, maximum water available for con-

sumption, and the total expenses for the water supply. The primary goal for this kind of modeling-regional development (RD) modeling—is to determine the location and development level for regional production units for the area's economy. The mathematical model measures water supply, comparing the feasibility of meeting different water demands at various supply schedules; and water quality management parameters which are examined in light of water withdrawal levels in a given number of regional subregions, or districts, resulting in or having various pollution concentration levels. The first version of the water supply model was applied to Silistra, Bulgaria. Findings indicate that water unit costs are much higher during intensive irrigation periods, these costs increase when the irrigated land is moved farther from the river water source (Danube River), and water costs increase strongly in areas lacking reservoirs. (Arnold-NC) W80-03587

#### THE DEVELOPMENT AND SERVICING OF SPATIAL DATA MANAGEMENT TECHNIQUES IN THE CORPS OF ENGINEERS.

Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch. R. P. Webb, and D. W. Davis. Technical Paper No 55, July 1978. 24 p, 7 Tab, 13 Ref.

Descriptors: \*Model studies, \*Analytical techniques, \*Flood control, \*Flood plain management, \*Spatial data management, \*Flood damage, Computer models, Computer techniques, Flood hazard, Flood data, Water resources planning, Planning, Environmental effects, Flood plains.

This study presents a system for managing hydrologic data and performing a comprehensive analysis of the impacts of existing and alternative future land use development patterns for floodplains. Spatial data management and processing techniques are employed using the group of software contained under DATA BANK PROCESSING INTERFACE. Various alternatives are evaluated for flood hazards for a specific storm event such as the 100-year flood, or for a range of storm events; monetary damages for a specific flood event and the expected value of annual damages are evaluated for 8 different alternatives; and alternative environmental impacts are evaluated. A series of Expanded Flood Plain Information Studies (XFPI) was undertaken using the techniques developed by the Corps. The original study was in the Oconee River Basin and has been completed; several others are near completion. Results of the Trail Creek watershed study are presented. The watershed occupies 12 miles of the Oconee pilot study area of 300 miles, and includes portions of Athens (GA). The area is 10% urban and expected to grow to 20-30% by 1990. The data bank developed for Trail Creek included 15 data variables. Flood hazard analysis presents results of evaluating existing and 1990 alternative conditions. Annual damage assessments for a range of hydrologic conditions and land use control policy sets are presented. Non-structural flood plain evaluations using spatial data management techniques are presented. Environmental assessments include current and 1990 Trail Creek pollutants. Recommendations applicable to tasks such as spatial data management include the need to provide the computer software with a permanent home, using business-like computer code generation, and careful selection of studies. (Arnold-NC) W80-03588

#### FLOOD DAMAGE ASSESSMENTS USING SPATIAL DATA MANAGEMENT TECHNIQUES.

Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch. D. W. Davis, and R. P. Webb. Technical Paper No 57, November 1978. 25 p, 4 Fig, 2 Tab, 5 Ref.

Descriptors: \*Analytical techniques, \*Flood damage, \*Flood control, \*Frequency analysis, \*Flood plain management, \*Spatial data management, Flood plains, Non-structural alternatives,

## Field 6—WATER RESOURCES PLANNING

### Group 6A—Techniques Of Planning

Computer techniques, Flood data, Water resources planning, Flood stage, Structures, Geography, Management, Land use, Hydrology.

This study discusses the basic concepts of a spatial data management approach to flood damage appraisals and highlights its integrated use with more traditional individual structure approaches. Two major types of appraisals are the 'event' analysis, involving the development of a damage potential function and hydrologic data for the flood event of interest; and the expected annual damage analysis which employs the methods of the first analysis plus adding data for representing a flow-exceedance frequency function. Development of flood damage potential functions is achieved by stratifying the particular flood plain by damage potential, sampling stratified categories, then projecting damage potential for the entire study area. For accomplishing these tasks, use of the grid cell data bank is employed, with coding of various cells for type of existing land use, damage reach, and particular reference flood. Summary damage evaluations will then be possible, each comparing the existing damage reaches with the type of land use policy existing for that area. An integrated spatial and inventory approach was designed to make these programs more useable by the public and local/state agencies. The applications made to date confirm the soundness of the approach and indicate that the methods should aid in continuing the important movement toward a geographic approach to flood plain management. (Arnold-NC) W80-03589

#### SPATIAL DATA ANALYSIS OF NONSTRUCTURAL MEASURES

Hydrologic Engineering Center, Davis, CA. Planning Analysis Branch.  
R. P. Webb, and M. W. Burnham.  
Technical Paper No 46, August 1976. 19 p, 8 Fig, 4 Tab, 2 Ref.

Descriptors: \*Model studies, \*Analytical techniques, \*Flood control, \*Nonstructural alternatives, \*Flood protection, \*Flood plain management, \*Flood damage, \*Flood plains, Planning, Flood proofing, Spatial analysis, Computer models, Structural damage, Flood data, Water resources development.

This article explains how evaluations of nonstructural flood loss reduction measures for existing and alternative future land use patterns can be made. A spatial data analysis model is advanced which employs the processing of spatial geographic data into a grid cell data bank which may then be accessed and manipulated in a computer bank. Inputs into the program include a description of flood damage reach boundaries; reference flood profiles; composite damage functions; and aggregate damage function data (e.g., value of the structure, density of development in the immediate area, stage vs. % damage for structure). Two major steps are involved in damage function development: (1) development of elevation-damage function at each cell, and (2) aggregation of cells to index locations by determining damage reach, index location, cell reference, then aggregating inputs for all cells. This method should make possible rapid evaluation of flood damage potential for existing and alternative future land use conditions and determination of potential flood damage resulting from various nonstructural measures. (Arnold-NC) W80-03590

### 6B. Evaluation Process

#### A DYNAMIC REGIONAL IMPACT ANALYSIS OF FEDERAL EXPENDITURES ON A WATER AND RELATED LAND RESOURCE PROJECT - THE BOISE PROJECT OF IDAHO, PART I: DIRECT ECONOMIC IMPACTS, ECONOMICS SUBPROJECT.

Idaho Univ., Moscow. Dept. of Agricultural Economics.  
R. Long, T. Nelson, and G. Hines.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-144280, Idaho Water Resources Research Institute, Univer-

sity of Idaho Research Technical Completion Report, March 1979. Volume I of V. 111 p, 7 Fig, 28 Tab, 26 Ref, 5 Append, OWRT C-6276(5226) (2).

Descriptors: \*Idaho, \*Cost-benefit ratio, \*Economic impact, \*Irrigation systems, Cereal crops, Field crops, Vegetable crops, Forages, Reservoir storage, Hydroelectric power, Flood control, Crop production, Agriculture, Irrigation programs, Boise Project.

Direct cost and return information is presented for the Boise Project, originally an irrigation and power project in southwestern Idaho. The Project was built by the Bureau of Reclamation from 1910 to 1956 and is now managed for irrigation, power, recreation, and flood control. Irrigated acreage in the area has increased from 51,377 acres to the current 390,000 acres with irrigation water from the Boise and Payette Rivers now stored in five reservoirs. Pre-project crops were primarily hay, grain, and pasture crops with a few seed crops, fruits, and vegetables. From 1910 to 1940 there was little change in crop patterns with forage and cereal crops continuing to dominate percentages while overall regional output increased. From 1940 to 1973 crop patterns changed with the technological and economic boom following World War II. Forage and cereal crops percentages dropped while seed, fruit, vegetable, and field crop percentages increased. Benefit-cost ratios (value added per dollar of project cost) are given for each year from 1910 to 1973. The lowest ratio occurred in 1932 at a negative \$0.59 and the highest ratio occurred in 1947 with \$21.29. The project was only marginally economically successful prior to 1940, however, after that date a rapid upswing occurred. For every dollar spent on the project after 1940 about \$5 in income resulted with the ratio for 1973 being \$9.94. (Seigler-IPA) W80-03309

#### A DYNAMIC REGIONAL IMPACT ANALYSIS OF FEDERAL EXPENDITURES ON A WATER AND RELATED LAND RESOURCE PROJECT - THE BOISE PROJECT OF IDAHO, PART III: ECONOMIC SCENARIO OF THE BOISE REGION 'WITHOUT' A FEDERAL IRRIGATION PROJECT, ECONOMICS SUBPROJECT, Idaho Univ., Moscow.

T. L. Nelson, C. C. Warnick, and C. J. Potratz.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-144298, Idaho Water Resources Research Institute, University of Idaho. Research Technical Completion Report, March 1979, Vol III of V, 61 p, 4 Fig, 16 Tab, 17 Ref, OWRT C-6276 (5226) (4).

Descriptors: \*Economic justification, \*Economic prediction, \*Comparative benefits, \*Idaho, \*Model studies, Irrigation systems, Cost-benefit ratio, Econometrics, Monetary benefits, Federal project policy, Projects, Estimated benefits, Project benefits, Project planning, Boise Project.

Two models were used to estimate the economic conditions in Idaho and the Boise region if the federally funded Boise Irrigation Project had never been built. A hydrologic model of the natural unregulated flows of the Boise and Payette Rivers was used to estimate the gross crop output that would have occurred without the Boise Project. Based on data from the hydrologic model an inter-regional trade flow model was also developed. Most of the precipitation for the two watersheds occurs as snow resulting in a heavy spring runoff. Flows then decline as summer progresses with August flows often being only 15% of June flows. Without the storage water provided by the Boise Project there would be little water for irrigation during the critical summer season. From the hydrologic model, average annual irrigation diversions available from both rivers without the Project was 705,000 acre feet. This diversion would have irrigated approximately 261,000 acres which in turn would produce \$8,600,000 in crops by 1973. A comparison of these 'without' results to actual 'with' data shows that in 1972 while the 'without' acreage represents 77% of the actual 'with' acreage, the 'without' diversion is only 36% of the 'with' diversion. Further, the 'without' income rep-

resents only 18% of the 'with' diversion. Trade flow model results show that area output 'without' the Project would have been \$1.6 billion compared to \$1.8 billion 'with' the project as of 1970. The pattern for income is similar. The relative success of the Project is justified on the basis of economic efficiency. (Seigler-IPA) W80-03311

#### A DYNAMIC REGIONAL IMPACT ANALYSIS OF FEDERAL EXPENDITURES ON A WATER AND RELATED LAND RESOURCE PROJECT - THE BOISE PROJECT OF IDAHO, PART IV: A SOCIAL IMPACT ANALYSIS OF FEDERAL EXPENDITURES ON A WATER RELATED RESOURCE PROJECT: BOISE PROJECT, SOCIAL SUBPROJECT, Idaho Univ., Kimberly. Water Resources Research Inst.

J. E. Carlson, and M. J. Sargent.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-144306, Research Technical Completion Report, March 1979. Vol IV of V, 134 p, 34 Fig, 6 Tab, 32 Ref, 1 Append, OWRT C-6276 (5226) (5).

Descriptors: \*Idaho, \*Social impact, \*Project benefits, \*Comparative benefits, Irrigation systems, Social change, Social aspects, Community development, Human population, Public health, Recreation, Education, Law enforcement, Boise Project.

Social changes resulting from the Boise Project, an irrigation and power project in southwestern Idaho are analyzed. The Project was built by the Bureau of Reclamation between 1910 and 1956 and is now managed for irrigation, power, recreation, and flood control. Both spatial and temporal impacts on Ada and Canyon Counties and changes from 1940 through 1970 are analyzed. A comparison is made of the quality of life 'with' the Project and 'without' the Project. Quality of life indicators used include education, housing and neighborhood, formal achievement, health (mental and physical), law enforcement, accessibility, and recreation. The most significant social impact has been on population numbers with the Project adding 38,000 to 22,000 residents from 1940 to 1970. Farm population has declined but not as sharply as it would have without the Project. The Project has apparently had little impact on education. Income has somewhat increased with fewer families classified as poverty level, however, the percent employed is little changed. Housing has been unaffected except for a quality improvement in 1940. Health has also been unaffected. Violent crimes and accessibility were slightly increased by the Project. Water-based recreation was greatly increased by the Project. Overall the apparent social impacts of the Boise Project have not been major. (Seigler-IPA) W80-03312

#### A DYNAMIC REGIONAL IMPACT ANALYSIS OF FEDERAL EXPENDITURES ON A WATER AND RELATED LAND RESOURCE PROJECT - THE BOISE PROJECT OF IDAHO, PART V: ENVIRONMENTAL IMPACTS, Idaho Univ., Moscow. Dept. of Geography.

J. E. Hultquist.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-144314, Research Technical Completion Report, March 1979. Vol V of V, 114 p, 16 Fig, 20 Tab, 102 Ref. Idaho Water Resources Research Institute, University of Idaho. OWRT C-6276 (5226) (6).

Descriptors: \*Idaho, \*Environmental effects, \*Irrigation, Habitats, Ecology, Productivity, Project benefits, Comparative benefits, Projects, Irrigation systems, Watersheds(Basins), Reservoir storage, Reservoir silting, Erosion, Water supply, Boise Project.

'Without Project' scenarios are compared to actual existing conditions to assess the environmental impact of the Boise Project, an irrigation and power project in southwestern Idaho. The Project was built by the Bureau of Reclamation between 1910 and 1956 and is now managed for irrigation, power, recreation, and flood control. One 'with'

## Evaluation Process—Group 6B

scenario examined is the natural flow scenario. Without any storage only the diversion of natural flows could have been used for irrigation. Most of the area's precipitation is in the form of snow producing a heavy runoff and high flows in spring and low flows in summer. The low flows of July and August would have determined the maximum amount of land to be irrigated for the entire season. Estimated average annual irrigated acreage from natural flow is 152,500 acres. A second 'without' scenario, the storage scenario assumes the construction of only a 200,000 acre-foot reservoir. This storage capacity would provide an additional 48,800 irrigated acres. It is difficult to attribute many environmental changes directly to the Boise Project as it is evident that a great many changes were underway prior to the Project. Environmental changes are discussed along with various environmental evaluation methodologies. (Seigler-IPA) W80-03313

#### ARCHEOLOGICAL INVESTIGATIONS ALONG THE SALT-GILA AQUEDUCT,

Museum of Northern Arizona, Flagstaff, P. H. Stein.  
Technical Report No. DI-BR-APO-CCRS 79-3, November 1979. Prepared for the U.S. Bureau of Reclamation, Arizona Projects Office, 181 p, 17 Fig, 15 Tab, 112 Ref, 5 Append.

Descriptors: \*Arizona, \*Archaeology, \*History, \*Dating, \*Surveys, \*Arid lands, Southwestern U.S., Irrigation practices, Agronomy, Agriculture, Water storage, Droughts, Hohokam culture, Salt-Gila Aqueduct, Central Arizona Project.

Seventy archeological and/or historical sites were recorded during an intensive archeological survey of the area involved in the construction of the proposed Salt-Gila Aqueduct (SGA), a component of the Central Arizona Project designed to supplement the water supply of central and southern Arizona. The SGA project area, located in the Southern Basin and Range physiographic province, is characterized by through-flowing drainage systems with no natural lakes. With an average annual rainfall of less than 10 inches and a high evapotranspiration rate, the Gila River was the main perennial source of water in aboriginal times. A site file search was conducted to gather data on all sites previously recorded. This search identified 51 sites. Although the presence of man in the American Southwest is documented from at least 11,000 B.C., the distribution of sites from the survey indicated that the most valuable period of archeological study was the Hohokam period (300 B.C. to 1450 A.D.). The Hohokam were a sedentary people practicing both canal irrigation and floodwater farming. They excelled in the production of stone, shell, and clay crafts. A testable model of riverine and nonriverine Hohokam settlement/subsistence was developed. Also, different levels of sampling intensity were compared for locating nonsite remains. Excavation of various sites should provide more conclusive data. (Seigler-IPA) W80-03321

**AN ANALYSIS OF WATER RESOURCES CONSTRAINTS ON POWER PLANT SITING IN THE MID-ATLANTIC STATES,**  
National Center for the Analysis of Energy Systems, Upton, NY.  
For primary bibliographic entry see Field 6D. W80-03361

**GEOTHERMAL WELL DRILLING ESTIMATES BASED ON PAST WELL COSTS,**  
Department of Energy, Idaho Falls, ID. Idaho Operations Office.  
R. N. Chappell, S. J. Prestwich, L. G. Miller, and H. P. Ross.  
Geothermal Resources Council, Transactions, Vol 3, p 99-102, September, 1979. 3 Fig, 2 Tab, 2 Ref.

Descriptors: \*Geothermal studies, \*Drilling, \*Estimated costs, Deep wells, Inflation, Planning, Regression analysis.

Nineteen geothermal wells of varying depths between 1500 and 10,000 feet and similar diameter

were used in a statistical analysis of well construction costs. The general trend when the data points are plotted is exponential with depth. However, costs at any given depth can vary appreciably due to drilling conditions and unexpected problems. The straight line fit should not be extrapolated to obtain costs for geothermal wells less than 1500 feet deep. All the cost data were corrected for inflation. Since 1974, well drilling costs have almost doubled. (Purdin-NWWA) W80-03427

**THE ECONOMIC FEASIBILITY OF DUAL PURPOSE NUCLEAR DESALINATION OF GROUND WATER,**  
New Mexico State Univ., Las Cruces. Dept. of Agricultural Economics.  
For primary bibliographic entry see Field 3A. W80-03544

**DAMS AROUND THE HOLY CITY OF MEDINA, AND THE PRESSURE ON ITS WATER SUPPLY,**  
Durham Univ. (England). Dept. of Geography. M. S. Makki.  
Journal of Arid Environments, Vol 2, No 4, p 363-367, Dec 1979. 1 Fig, 12 Ref.

Descriptors: \*Urbanization, \*Paleohydrology, \*Dams, \*Water demand, Environmental effects, Quaternary period, Tertiary period, Infiltration, Water supply, \*Saudi Arabia, \*Medina.

Recent intensive use of machine pumps, drier weather, increasing urbanization, and improvements in health care around Medina, a holy city of more than 100,000 which receives about a million pilgrims yearly, have created a growing problem of providing water for domestic and agricultural use. Medina's water now comes from a huge water storage trap formed from Tertiary and Quaternary basalt outpourings south of the city. It covers the ancient alluvium into which rainwater would otherwise infiltrate and protects groundwater from evaporation. The resultant limitation on infiltration along with the increasing extraction of groundwater have created imbalances in which demands far exceed precipitation. Several dams built in the area to increase the recharge by rainwater to the aquifer, are described in terms of their varying effects on valley floods and their implications in meeting water demands. It is concluded that the recent flexibility of official policy toward urban expansion, together with lack of water, have badly affected the natural environment around Medina. (Tickes-Arizona) W80-03549

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XIV-APPENDIX M, FLOOD CONTROL,**  
Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 2E. W80-03569

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XIII-APPENDIX L, NAVIGATION,**  
Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 280, Price codes: A06 in paper copy, A01 in microfiche. Prepared for the Ohio River Basin Coordinating Committee, April 1968. 113 p, 23 Fig, 15 Tab, 1 Append.

Descriptors: \*Water resources development, \*Multiple purpose projects, \*Ohio River Basin, \*Resources development, \*Navigation, \*Comprehensive planning, \*Projections, \*Navigable rivers, Transportation, Water use, Canals, Commerce, Waterways, Water demand, Natural resources, Water policy, Regional development, Navigable waters.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly within Ohio, Indiana, West Virginia, Kentucky, Tennessee and Illi-

nois. The main purposes are to determine the need for further flood control measures and to enhance the economic well being of the Basin. This Appendix delineates problems and development needs of the Basin's navigation system and presents a methodology for projecting annual gross demands on that system. By 2020, annual tonnage and ton-miles moved on the Ohio River are projected to increase more than 5 times the 1965 traffic; on tributaries in the study area, projected growth would be more than threefold. Additional demand for water-borne freight exists in areas of the Basin where there is presently no service but where potential waterways should be feasible before 2010. If these system extensions are constructed as needed, 6 billion ton-miles are projected to move on 320 new waterways by 2020. Structural measures are recommended to meet increasing demands, including deeper navigation channels and a lock-and-dam modernization program. In addition, technological and managerial measures will be necessary to meet projected needs. Total initial construction costs of the navigation development plan to 2020 is estimated at \$1.8 billion, excluding projects in the 1965 program. Specific navigation problems and potential solutions for these problems are presented for each of the rivers in the Ohio River Basin. A comprehensive development program is also presented for navigation, including existing and projected new waterways. (Arnold-NC) W80-03570

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XII-APPENDIX K, DEVELOPMENT PROGRAM FORMULATION,**  
Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 279, Price codes: A14 in paper copy, A01 in microfiche. Prepared for the Ohio River Basin Coordinating Committee, July 1968. 317 p, 22 Fig, 28 Tab, 4 Attachments.

Descriptors: \*Water resources development, \*Water resources planning, \*Water demand, \*Ohio River Basin, \*Administration, \*Multiple purpose projects, \*Regional development, \*Water supply development, Planning, Economic projections, Governments, Water resources, Recreation, Power demand, Water policy, Natural resources, Water quality.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly within Ohio, Indiana, West Virginia, Kentucky, Tennessee and Illinois. The main purposes are to determine the need for further flood control measures and to enhance the economic well being of the Basin. This Appendix presents background information, planning concepts and procedures, and—as an end product—a generalized plan for the development and management of water and related land resources of the Basin. The study region comprises 163,000 square miles and is rich in water, mineral and other resources. Population will triple by the 21st Century, with water use and demand increasing greatly for such activities as electric energy requirements, recreation, municipal and industrial water use, hunting and fishing, and water-borne freight. Flood control improvements will be needed. Control of stream flows and coordinated development and use of streams and impounded waters will be important in meeting future demands on available resources. The proposed Framework Program plan would call for tripling reservoir storage capacity from 1980 to 2020, increasing hydroelectric capacity by the same amount, adding 15-30% more acreage to public lands to meet projected recreation demand, and the acceleration of all water-resource-oriented planning programs in existence to cope with this increased demand. (Arnold-NC) W80-03571

**OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME X-APPENDIX I, ELECTRIC POWER,**  
Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 278, Price codes: A05 in paper copy, A01 in microfiche.

## Field 6—WATER RESOURCES PLANNING

### Group 6B—Evaluation Process

Prepared for the Ohio River Basin Coordinating Committee by the Federal Power Commission, 1966. 92 p, 13 Tab, 6 Exhibits.

Descriptors: \*Water resources development, \*Electric power, \*Ohio River Basin, \*Electric power demand, \*Electric power production, \*Cooling water, Water demand, Hydroelectric power, Water policy, Thermal power.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly within Ohio, Indiana, West Virginia, Kentucky, Tennessee and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin. This Appendix assesses data for and predicts future demand for power in the Ohio Basin. Energy requirements for power generation in the Basin are expected to increase about 200% between 1963 and 1980 and an additional 370% between 1980 and 2020. Total generating capacity is expected to increase 225% between 1963 and 1970 and an additional 75% from 1970 to 1980, but no specific growth forecasts are given for 1980-2000. Hydroelectric development will increase somewhat, but then level off near the end of the century as nuclear power plays a greater role in meeting energy requirements. Available surface and ground water resources in the Basin appear to be sufficient to satisfy cooling water needs of thermal electric generation in the foreseeable future. With more energy efficient thermal plants coming on line by 1980, cooling water requirements will be gradually reduced. Because of unforeseen technical advances in power plants, exact predictions of cooling water requirements for the period beyond 2000 are not feasible at this time (1966). (Arnold-NC)  
W80-03572

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME IX-APPENDIX H, OUTDOOR RECREATION.

Army Engineer Div. Ohio River, Cincinnati. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 277. Price codes: A09 in paper copy, A01 in microfiche. Prepared by the U.S. Department of the Interior, Bureau of Outdoor Recreation for the Ohio River Basin Coordinating Committee, June 1966. 197 p, 4 Tab, 21 Plates, 4 Append.

Descriptors: \*Water resources development, \*Outdoor recreation, \*Ohio River Basin, \*Multiple purpose projects, \*Recreation demand, Recreation facilities, Projections, Natural resources, Planning, Land use, Social aspects, Water policy, Economics.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly that portion in Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin. This Appendix assesses the demands and needs for water related outdoor recreation opportunities of the Basin by regional summary and for each of the Basin's subareas in the years 1980, 2000, and 2020. All 19 subareas have a need for additional development to meet future needs. For the 3 target years, demands will increase more than 2-fold, 4-fold, and 6-fold, respectively, over 1960 demands. Recreation needs by 2020 are projected to be 971.3 million recreation days, with resource requirements estimated to be up to 8,741,700 land acres and 9,207,900 water acres by 2020, at development costs of up to \$4,370,800. The report recommends planning and development programs for all 19 subareas, with special attention given to 7 subareas. Detailed studies of navigation waterways should be undertaken to determine the extent they can be used to alleviate recreational needs; scenic roads and parkways should be developed, and potential scenic riverways studied to determine their recreation capabilities; and recreational programs of all agencies administering recreation facilities should be considered in future planning. (Arnold-NC)  
W80-03573

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME VIII-APPENDIX G, FISH AND WILDLIFE RESOURCES.

Army Engineer Div. Ohio River, Cincinnati. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 276. Price codes: A06 in paper copy, A01 in microfiche. Prepared by the U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, and Bureau of Commercial Fisheries for the Ohio River Basin Coordinating Committee, 1963. 99 p, 8 Tab, 8 Plates, 12 Photographs, 3 Supp.

Descriptors: \*Water resources development, \*Fish and wildlife, \*Multiple purpose projects, \*Ohio River Basin, \*Fish management, \*Commercial fishing, \*Sport fishing, \*Hunting, \*Wildlife management, Freshwater fish, Fisheries, Natural resources, Aquatic life, Planning.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin System, particularly that portion in Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin. The purpose of this Appendix is to analyze fish and wildlife resource problems in the Basin and to furnish general solutions, particularly related to potential water development projects. Gross demand for sport fishing will increase 62% by 1980, 88% by 2000, and 138% by 2020 over 1960 actual Basin use. Hunter demand will also increase though at a slower rate—32% by 2020. Neither fish nor game resources will be adequate to meet these needs. Expanding human populations limit the Basin's habitat base. Providing for projected 1980 fishing needs could involve an annual estimated expenditure of \$1,100,000-\$3,900,000. Projected sub-basin sport fishing needs could be met by: creating ponded waters; improving water quality by curbing pollution; providing equitable zoning of use on available waters; rehabilitating or reclaiming fishing waters; acquisition of greater public access to fishing waters; planning for future needs; and avoiding degradation of habitats. Future hunter needs could be met by more intensive management of public hunting lands; introduction of new species; opening new hunting lands; and planning. (Arnold-NC)  
W80-03574

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME VII-APPENDIX F, AGRICULTURE.

Army Engineer Div. Ohio River, Cincinnati. For primary bibliographic entry see Field 6D. W80-03575

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME III-APPENDIX B, PROJECTIVE ECONOMIC STUDY.

Army Engineer Div. Ohio River, Cincinnati. For primary bibliographic entry see Field 6A. W80-03579

#### OHIO RIVER BASIN—COMPREHENSIVE SURVEY: VOLUME II-APPENDIX A, HISTORY OF STUDY.

Army Engineer Div. Ohio River, Cincinnati. For primary bibliographic entry see Field 6D. W80-03580

#### DESIGNING FOR DEVELOPMENT: WHAT IS APPROPRIATE TECHNOLOGY FOR RURAL WATER AND SANITATION.

D. Henry. Water Supply and Management, Vol 2, No 4, p 365-372, 1978. 1 Fig.

Descriptors: \*Rural water supply, \*Developing countries, \*Water technology, \*Rural areas, \*Water resources development, \*Water supply development, Technology, Water supply, Strategies, International Development Research Centre, Costs, Planning, Resources development, Research and development.

In developing countries 90% of the populations live in rural areas. In these societies the non-conventional energy sources are the electric motor and diesel engine and the conventional energy sources are animal and human power, sometimes supplemented by wind and water power. Women carry almost 100% of the water for domestic purposes, spending more than 50% of their time doing so. The International Development Research Centre has been conducting research of rural water technology. Their research philosophy focuses on: (1) national priority; (2) utilization of local personnel and resources; (3) rural emphasis; (4) applicability, and (5) research training. A major problem in rural areas is that these people do not have a revenue collection system through which payments for both capital and operating costs of rural water supply programs can be collected. One of the most essential tools in the rural water field will be an effective system for the generation, collection and dissemination of information. Basic criteria for selection of rural water technology are that any technology must be capable of fabrication within the developing country; and that it must be reliable, have a reasonable cost and be maintainable by villagers. The most difficult part of the appropriate technology equation is getting the technology into the marketplace after the design has been tested and optimized. In developing rural water systems the challenge is to produce machines that will make poor people more productive and to ensure that the villager becomes an active member of the research team since he is the focal point of all this activity. (Iervolino-NC)  
W80-03592

#### IDENTIFYING RESEARCH PRIORITIES IN WATER DEVELOPMENT.

R. Chambers. Water Supply and Management, Vol 2, No 4, p 389-398, 1978. 11 Ref.

Descriptors: \*Research priorities, \*Water resources development, \*Rural water supply, \*Water demand, Water supply, Developing countries, Productivity, Equity, Rural areas, Planning, Decision-making, Social aspects, Research and development.

Factors influencing priorities in water-related research are discussed, along with complementary and corrective approaches, and examples of the kinds of priorities which might emerge. The focus concerns improving the levels of living of the people, especially the poorer people, in rural areas of the third world. Professional training and prestige, biases of dominance, difficulties of studying water, and the problem-orientation are factors which influence priorities in water-related research. In determining research priorities, more specific criteria might include productivity, equity, stability, quality of life, and non-seasonality. A suggested water research and development approach to counterbalance current biases would include five main complementary elements: (1) working with and learning from rural people; (2) holistic appraisal; (3) opportunity orientation; (4) creative lateral thinking; and (5) practicality. Changes following on from water-related research might help rural development generally and the poorer rural people in particular. Some priorities for research include water reform, traditional domestic technologies, water-appropriating technology, water conservation and storage, and slack resources for the poor. The potential for increased agricultural production and more equitable distribution of water to farmers on existing irrigation systems is enormous. Organization and management of irrigation bureaucracies is needed to ensure more productive and equitable distribution of water. The design and choice of pump technology has great potential and needs to be investigated further. Obvious opportunities are presented by reducing evaporation from open bodies of water, reducing seepage from channels, dams and tanks, and the artificial recharge of groundwater. (Iervolino-NC)  
W80-03594

## Water Demand—Group 6D

## 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

## ECONOMICS OF IRRIGATION AND THE INSTITUTIONAL AND PRICING SYSTEMS OF WATER IN ISRAEL

Hebrew Univ., Rehovot (Israel). Faculty of Agriculture.

D. Yaron.

Agricultural Water Management, Vol 2, No 3, p 203-216, Nov 1979. 1 Fig, 3 Tab, 30 Ref.

Descriptors: \*Economic efficiency, \*Irrigation efficiency, \*Pricing, \*Planning, Institutional constraints, Market value, Water rates, \*Israel, Water conservation, Water Resources Development.

Economic analyses of irrigation performed in Israel show the many facets and complexities of ascertaining the value of irrigation water. This paper reviews some of the relationships existing between progress made in the economics of irrigation and the institutional framework and system of water pricing. Israel provides a good example because of its fast rate of development of irrigated land, adaptation and/or development of advanced irrigation methods, and the scarcity of irrigation water which emphasizes the need for an efficient use of this resource. It is suggested that the essence of the relationships discussed is that under conditions of water scarcity and the existence of a conceptual understanding of the economic relationships involved in irrigation, pressure develops to adapt the institutional and pricing systems to obtain a more rational use. This adaptation process must overcome resistance typical of any institutional framework and the pressure of opposing interest groups. (Tickes-Arizona)

W80-03554

## MANAGING SMALL WATER SYSTEMS: A COST STUDY, VOLUME II

ACT Systems, Inc., Winter Park, FL.

J. I. Gilleen, W. K. Adams, and R. M. Clark.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-126410, Price codes: A14 in paper copy, A01 in microfiche. Environmental Protection Technology Series Report No EPA-600/2-79-147b, September 1979. 304 p, 25 Fig, 4 Tab, 2 Ref, 3 Appendix. 68-03-2071.

Descriptors: \*Cost-benefit analysis, \*Econometrics, \*Water costs, \*Data collections, Utilities, Water works, Water rates, Taxes, Water delivery, Labor, Regression analysis, Productivity, Maintenance costs, Water supply, Depreciation.

Financial data and operations are reported for 23 selected small water utilities. Data are given for a 10 year period for support services, acquisition, treatment, delivery, chemicals, payroll, and power. These data are analyzed in Volume I in which depreciation expense is examined for each of the above as to its relative capital intensiveness. To allow for comparisons between utilities the amount of revenue-producing water is used in all calculations. Cost analyses show that distribution remains the most significant cost component. Labor costs, a major part of total operational and maintenance costs, have more than doubled in many cases for the period studied. Labor costs and productivity are mathematically related to capital productivity and costs to examine the cost impact of increased output in terms of payroll and capital expenditures. Inflation effects are also analyzed in Volume I for the utility budgets. A cost analysis summary for the last year of record is given for 23 utilities. Brief Descriptions of the individual utilities are given including location, operation, and a schematic diagram of the system used. Extensive printouts of data for each utility are included. (Seigler-IPA)

W80-03568

## 6D. Water Demand

## BETTER UTILIZATION OF GROUND WATER IN THE PIEDMONT AND MOUNTAIN REGION OF THE SOUTHEAST

Geological Survey, Raleigh, NC. Water Resources

Div.

R. C. Heath.

In: Water Conservation and Alternative Water Supplies—Proceedings of a Southeast Regional Conference, November 8-9, 1978, Georgia Institute of Technology, p 145-160, 1979. 10 Fig, 4 Ref.

Descriptors: \*Water utilization, \*Groundwater, \*Southeast U.S., \*Water supply, Surface waters, Water demand, Projections, Planning, Groundwater resources, Domestic water, Wells, Cities, Municipal water, Industrial water, Reservoir silt, Water requirements, Water table, Bedrock, Precipitation (Atmospheric), \*Piedmont region, \*Blue Ridge Mountain region.

Ground water in the Piedmont and mountain region of the Southeast, United States, is widely used for rural domestic, small municipal, and industrial water supplies. Surface reservoirs are the primary source of water for large cities and industries. Water use is expected to triple in the next 40 years and during this period many of the best reservoir sites will be occupied by cities, industries, and other high-cost developments and the yield of existing reservoirs will be reduced by sedimentation. Meeting the water needs of the region will require intensive development of ground water to supplement supplies from reservoirs. (See also W80-00001) (Kosco-USGS)

W80-03327

## AN ANALYSIS OF WATER RESOURCES CONSTRAINTS ON POWER PLANT SITING IN THE MID-ATLANTIC STATES

National Center for the Analysis of Energy Systems, Upton, NY.

B. F. Hobbs, and P. M. Meier.

Water Resources Bulletin, Vol 15, No 6, p 1666-1676, December 1979. 3 Fig, 2 Tab, 21 Ref. DOE EY-76-C-02-0016.

Descriptors: \*Water resources, \*Water demand, \*Powerplants, \*Cooling water, \*Northeast U.S., Model studies, Mathematical models, Water requirements, Water users, Evaporation, Consumptive use, Low flow, Low-flow augmentation, Water pollution, Thermal pollution, Environment, Environmental effects, Electric power, Electric power industry, \*Mid-Atlantic states.

Expansion of the electrical generation system in the Pennsylvania-Jersey-Maryland power pool will impact, and be constrained by, inland water availability. Future interpretations of the Federal Water Pollution Control Act Amendments of 1972 regarding evaporative cooling towers for coastal power plants, offshore siting and energy centers, and the policies and public acceptability of low flow augmentation reservoirs were some of the issues examined in this paper using scenarios generated by the Brookhaven National Laboratory Regional Energy Facility Siting Model (REFS). REFS is a multimodel, transshipment-location, linear programming model used to allocate power plants among counties in a power pool under a minimization of cost objectives. The solutions are sensitive to the water resources assumptions in the model. For the year 2000, the amount of low flow augmentation allowed in the region's river basins and whether off-shore siting becomes a reality are the two water resources related issues which most affect the scenarios. The results showed that decisions regarding specific water problems can have region-wide implications for water- and nonwater-related issues. (Sims-ISWS)

W80-03361

## PLANNING FOR DEVELOPMENT OF GROUNDWATER AND SURFACE WATER RESOURCES

Central Water Planning Unit, Reading (England).

For primary bibliographic entry see Field 2E.

W80-03450

## SOCIO-ECONOMIC CHANGES AND DEVELOPMENT OF WATER RESOURCES IN SAUDI ARABIA

King Abdulaziz Univ. Jeddah (Saudi Arabia). Dept. of Biology.

K. H. Batanouny.

In: Modeling, Identification and Control in Environmental Systems, p 935-950, North-Holland Publishing Company, 1978, 2 Fig, 7 Tab, 10 Ref.

Descriptors: \*Saudi Arabia, \*Water resources development, \*Groundwater, \*National economic development, \*Water demand, \*Arid lands, Regional development, Water table aquifers, Deserts, Water supply development, Oases, Desalination, Governments, Water supply, Water table, Wells.

Problems and constraints in matching Saudi Arabia's water resources needs to that country's greatly expanded level of economic development are explored. Summary reviews are given of Saudi oil production, national physical features, rainfall, groundwater resources, surface water, and city water supply. With more than 2.2 million sq km, representing about 1.5% of the land area of the earth and 5% of its arid zone, Saudi Arabia is the largest country in the world without a river, and rainfall there is too scanty in the largest portion of the country to sustain agriculture. Water scarcity is one of the country's chief constraints on national life, and water resources development accordingly has received highest government priority. Because groundwater is almost the only widespread water source (the cases of the Beduin population are supplied from groundwater sources) government attention is focused mainly on ways to sustain and improve water supply from the ground. The government has recently engaged in extensive inventorying, planning and feasibility studies in regard to groundwater supplies. In addition, a sea water desalination program began in 1965 and six desalting plants with a capacity of 12.86 million gallons/day are in operation. Finally, various water supply schemes for the country's villages have been implemented, including well-drilling and installation of motor-driven pumps. (Harris-Wisconsin)

W80-03502

## MUNICIPAL WATER USE

Utah Water Research Lab., Logan.

R. D. Hansen, H. H. Fullerton, and T. C. Hughes. Utah Science, Vol 40, No 2, p 51-53, June 1979. 4 Fig, 8 Ref.

Descriptors: \*Water demand, \*Water utilization, \*Municipal water, \*Water rates, \*Water consumption (Except consumptive use), Water distribution, Utah, Forecasting, Water conservation, Water loss, Optimum development plans, Semiarid climates, Water resources planning.

In the first such inventory since 1960, the water usage in 50 of Utah's largest municipal systems serving a combined population of 877,000, is described, including estimates of per capita use rates, water use determinants, and future water use rates. It is concluded that Utahns use considerably more water per capita than the national average, to some extent because of the semiarid climate and watering requirements of lawns and gardens. It is expected that increases in price and decreases in the average size of residential lots will precipitate a decrease in water usage. Municipal systems which now accept losses in their distribution systems will likely choose at some future time to reduce leakage in lieu of developing new supplies, for which reason it would appear inappropriate for planners to include a growthrate in per capita demands. (Tickes-Arizona)

W80-03551

## OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XIII—APPENDIX L, NAVIGATION

Army Engineer Div. Ohio River, Cincinnati.

For primary bibliographic entry see Field 6B.

W80-03570

## OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XII—APPENDIX K, DEVELOPMENT PROGRAM FORMULATION

Army Engineer Div. Ohio River, Cincinnati.

For primary bibliographic entry see Field 6B.

W80-03571

## Field 6—WATER RESOURCES PLANNING

### Group 6D—Water Demand

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME X-APPENDIX I, ELECTRIC POWER.

Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 6B.  
W80-03572

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME IX-APPENDIX H, OUTDOOR RECREATION.

Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 6B.  
W80-03573

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME VII-APPENDIX F, AGRICULTURE.

Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 275. Price codes: A03 in paper copy, A01 in microfiche. Prepared by the U.S. Department of Agriculture, Soil Conservation Service, Economic Research Service, and Forest Service for the Ohio River Basin Coordinating Committee, 1966. 173 p, 44 Tab, 5 Plates.

Descriptors: \*Water resources development, \*Multiple purpose projects, \*Water requirements, \*Forestry, \*Land classification, \*Ohio River Basin, \*Agriculture, Reservoirs, Flood control, Water demand, Recreation, Fish and wildlife, Groundwater, Water resources, Water supply, Planning, Irrigation, Water conservation, Land management, Conservation.

This is part of a larger study undertaken to provide data for comprehensive planning for the Ohio River Basin, particularly for that portion within Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance the economic well being of the Basin. This Appendix assesses the current status of agricultural resources in the Basin and provides projections for the future growth of agriculture in the region for the years 1980, 2000, and 2020. The water problems analyzed include floodwater and sediment damage to crops, rural lands and urban areas; impaired drainage of agricultural lands; agricultural drought problems and irrigation requirements; and water needs for livestock and other uses. The report includes a general description of the agricultural resource base and the agricultural economy. Demands for water and related land resource development are presented, including flood prevention, recreation, fish and wildlife, and water supply. The present status of water and related land resources is discussed and a discussion of water availability in upstream areas is presented. Specific needs and problems are discussed. Conclusions indicate that agricultural lands are available to meet expected demands to 2000; multiple use of lands should be increased; water yields are adequate for farm and rural use; proper land management is essential for conservation; production and sediment reduction; more reservoirs should be constructed and better water quality control should be exercised in upstream areas; and greater flood protection measures will also be needed. (Arnold-NC) W80-03575

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME VI-APPENDIX E, GROUNDWATER.

Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 2F.  
W80-03576

#### OHIO RIVER BASIN—COMPREHENSIVE SURVEY: VOLUME II-APPENDIX A, HISTORY OF STUDY.

Army Engineer Div. Ohio River, Cincinnati.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 270. Price codes: A07 in paper copy, A01 in microfiche. Prepared for the Ohio River Basin Coordinating Committee, August 1969. 147 p, 4 Tab, 1 Chart, 1 Attachment.

Descriptors: \*Water resources development, \*Ohio River, \*Water supply development, \*River basin development, \*Multiple purpose projects, \*Water resources planning, Framework studies, U.S. Water Resources Council, Legislation, Floods, Water management (Administrative), Regional development, Water policy, Water resources, Water requirements.

This is part of a larger study undertaken to provide a data base for comprehensive planning for the Ohio River Basin System, particularly within Ohio, Indiana, West Virginia, Kentucky, Tennessee, and Illinois. The main purposes are to provide for further flood control measures and to enhance economic well being of the Basin through water resource development. This Appendix details the history of the study, the authority under which it was established, and the policies and procedures followed. In planning and coordinating the study schedule, the Performance Evaluation and Review Technique (PERT) was employed. A Coordinating Committee consisting of representatives from seven federal agencies and each of the 11 states in the basin was established. Its principal functions were to provide a basis for full and continuing exchange of views; to advise and assist all participating agencies with regard to their objectives, work assignments and schedules; to assist in resolution of study problems as they arose; and to make periodic reviews of progress. Summaries are presented of each of the 15 meetings—which included public input—held by the Committee. Reviews are presented of federal and non-federal water and related land resource development programs which were presented for that portion of the basin in which the meeting was held. Study progress was reported at each meeting and any new information relating to the study was presented. Observer questions and comments were solicited at the end of each meeting. The Water Resources Council Guidelines for Framework Studies are included as an appendix to this volume. (Arnold-NC) W80-03580

#### DESIGNING FOR DEVELOPMENT: WHAT IS APPROPRIATE TECHNOLOGY FOR RURAL WATER AND SANITATION.

For primary bibliographic entry see Field 6B.  
W80-03592

#### IDENTIFYING RESEARCH PRIORITIES IN WATER DEVELOPMENT.

For primary bibliographic entry see Field 6B.  
W80-03594

### 6E. Water Law and Institutions

#### WILD RIVER INVENTORY.

Heritage Conservation and Recreation Service, Philadelphia, PA.  
J. G. Eugster.  
Water Spectrum, Vol 12, No 1, p 28-37, Winter 1979, 13 Fig.

Descriptors: \*Northeast U.S., \*Rivers, \*River Basin Development, \*Wild Rivers, \*Preservation Watershed management, Conservation, Water conservation, Water resources development, Protection, Land use, Watersheds (Basins), Regions, Topography, Water pollution control, River systems, Potomac River, Delaware River, Wild River Act, Scenery, Water policy.

A 13-state, Maine to Virginia, inventory of the Northeast was conducted to identify rivers for potential inclusion in the National Wild and Scenic Rivers System (NWSRS). The inventory, begun in 1975, identified more than 5300 miles along 171 rivers that are in relatively natural condition and merit some type of protection, conservation, or preservation measures. Similar evaluations were made in the Southeast and Lake Central Regions. For inclusion in NWSRS a river must be free-flowing, free of certain types of alterations, be largely undeveloped, and be adjacent to a related land area that possesses multi-state or national significance. Categories of information inventoried and evaluated include descriptive, geological-eco-

logical, wilderness, scenic, cultural, and recreation. Most rivers identified are in the northern and southern extremes of the Northeast Planning Region (Virginia, West Virginia, and Maine) away from major urban areas. However, more than 9% of the river miles identified are within 50 miles of cities of 50,000 or more. The rivers are identified by state and physiographic section. Eighty-five percent of the rivers identified are medium-to-small-sized. Of the large rivers only about 825 miles of the Potomac, Penobscot, Delaware, and St. Croix Rivers were identified. The Northeast has the smallest number of rivers in the NWSRS compared to all other areas in the continental U.S. Already in the system are portions of the Delaware and Allegheny Rivers. Major benefits of the inventory are listed including: making information available, identifying preservation opportunities, and building a communications network. (Seigler-IPA) W80-03317

#### GROUNDWATER RIGHTS IN VERMONT: DRINKWINE V. STATE.

J. P. Sahl.  
Vermont Law Review, Vol 4, No 1, p 189-202, Spring 1979.

Descriptors: \*Vermont, \*Groundwater availability, \*Absolute ownership doctrine, Groundwater, Groundwater resources, Judicial decisions, Prior appropriation, Reasonable use, Correlative rights, Water management (Applied).

The state of Vermont follows the absolute ownership doctrine of groundwater allocation. This means a surface owner has virtually unrestricted ownership and use of groundwater beneath his property. The doctrine, and the Vermont Supreme Court's recent reaffirmation of it are the subject of this commentary. The historical development of absolute ownership is reviewed, and the alternative doctrines of reasonable use, prior appropriation and correlative rights are considered. Modern developments in hydrology have significantly undermined the rationale for adherence to the absolute ownership rule because the movement and quantity of groundwater is now ascertainable. Every state, except Vermont, that follows the absolute ownership rule has modified it to exclude waste and malicious diversion. Pollution and depletion of groundwater supplies are other problems inadequately handled today by the absolute ownership doctrine. The correlative rights doctrine is the favored alternative. In addition, comprehensive legislation and a strong administrative agency is advocated as the best approach to solving water problems in general and groundwater problems in particular. (MacGregor-Florida) W80-03403

#### WATER RESOURCES COMMITTEE (ANNUAL REPORT): SURVEY OF WYOMING WATER LAW 1975-78.

American Bar Association, Washington, DC.  
Natural Resources Lawyer, Vol 12, No 1, p 311-326, 1979.

Descriptors: \*Wyoming, \*Judicial decisions, \*Legislation, \*Administrative decisions, Dams, Water rights, Appropriation, Water transfers, Irrigation, Groundwater, Water law.

The most significant Wyoming water law passed in 1975 was the law creating the Wyoming Water Development Program. This statute establishes procedures whereby the state can actively become involved in the construction and operation of water development projects. An important session law in 1976 authorized the appropriation of \$250,000 to the attorney general for maintaining Wyoming's rights to the state's waters. Numerous session laws were passed in 1977 dealing with the determination of water rights, appropriation, water projects, plant siting and dam inspection. In 1978, the legislature authorized the Department of Economic Planning and Development to proceed with the construction of a well supply and water transmission project. The judicial activity in Wyoming is also reviewed. The Supreme Court held that owners of reservoirs are not subject to absolute liability for damage done by escaping water. These

were several major decisions by administrative boards. A change from irrigation use to steam power plant use was approved. Another change in appropriations from irrigation to preferred industrial use was granted. Groundwater storage by the Conservation District was also approved. (Quarles-Florida)  
W80-03404

**WATER QUALITY COMMITTEE (ANNUAL REPORT).**  
American Bar Association, Washington, DC.  
For primary bibliographic entry see Field 5G.  
W80-03405

**FLOODPLAIN AND WETLANDS MANAGEMENT (FINAL RULE).**  
National Aeronautics and Space Administration, Washington, DC.  
Federal Register, Vol 44, No 3, p 1089-1092, January 4, 1979.

Descriptors: \*Floodplains, \*Wetlands, \*Management, Public rights, Maintenance, Regulation, Environmental control, Federal government, Permits.

This final rule provides guidelines and details procedures to the National Aeronautics and Space Administration (NASA) headquarters and field installations for the uniform implementation of Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands. NASA has a limited scope of activities in floodplain and wetland areas, the latter being subject to management by the United States Fish and Wildlife Service. The rule encompasses the responsibility of NASA officials, general implementation requirements and procedures for evaluating NASA actions impacting floodplains and wetlands. The rule is intended to assure: (1) that harm to lives, property and floodplain values is properly minimized; (2) that applicants for facilities use permits and grants evaluate the effect of their proposals on floodplains and wetlands prior to NASA approval; and (3) that proper restrictions are placed on property proposed for lease, easement and disposal to non-federal public or private parties. The rule defines and expands the public audience and ensures their continuous involvement in floodplain decision-making. (Corey-Florida)  
W80-03406

**PUBLIC USE OF WATER RESOURCES DEVELOPMENT PROJECTS ADMINISTERED BY THE CHIEF OF ENGINEERS (FINAL RULE).**  
Corps of Engineers, Washington, DC.  
Federal Register, Vol 44, No 47, p 12671-12679, March 8, 1979. 2 Append.

Descriptors: \*Water resources development, \*Public access, \*Recreation, Water resources, Regulation, Swimming, Camping, Hunting, Fishing, Trapping, Lakes.

The Department of the Army, acting through the Chief of Engineers, published more effective management of Corps of Engineers water resource development projects. The purpose of these rules is to clarify and strengthen existing rules and regulations and eliminate duplication of regulations. Part 327 of the final rule governs public use of water resource development administered by the chief of engineers. These regulations cover the following items as well as others: policy; vehicles, vessels; swimming; camping; hunting; fishing; trapping; sanitation; fires; restrictions; explosives, firearms, other weapons and fireworks; abandonment of personal property; advertisements; outgated lands; recreation use fees; and lakeshore management of Civil Works Projects. These regulations apply to water resource development projects completed or under construction, administered by the Chief of Engineers, and to those portions of jointly administered projects under the administrative jurisdiction of the Chief of Engineers. (Walker-Florida)  
W80-03407

**CONSISTENCY FOR DEPARTMENT OF THE INTERIOR OUTER CONTINENTAL SHELF (OCS) PRELEASE SALE ACTIVITIES AND FOR OTHER FEDERAL ACTIVITIES DIRECTLY AFFECTING THE COASTAL ZONE (FINAL RULE).**  
National Oceanic and Atmospheric Administration, Washington, DC.  
Federal Register, Vol 44, No 123, p 37142-37161, June 25, 1979.

Descriptors: \*Continental shelf, \*Management, \*Coasts, Public rights, Leases, Federal jurisdiction, State jurisdiction, Permits, Regulation, Environmental control.

This final rule amends existing regulations to conform with the April 20, 1979 United States Justice Department opinion. This opinion concluded that the Department of the Interior's Outer Continental Shelf (OCS) prelease sale activities which directly affect the coastal zone must be undertaken in a manner consistent, to the maximum extent practicable, with the requirements of approved coastal management programs in accordance with Section 307(c)(1) of the Coastal Zone Management Act (CZMA), as amended. The opinion further provided that the phrase 'directly affecting' in Section 307(c)(1) of the CZMA, which specifically applies to OCS prelease sale activities, should be included in the regulations, instead of using present language such as 'significantly' affecting the coastal zone in terms of 'primary', 'secondary', and 'cumulative' impacts. The amendments to the regulations also include minor editorial modifications and corrections and became effective June 25, 1979. (Corey-Florida)  
W80-03408

**PROCEDURAL CONSIDERATIONS IN THE JUDICIAL DETERMINATION OF WATER DISPUTES.**  
T. Toner.  
Land and Water Law Review, Vol 8, No 2, p 513-535, 1973.

Descriptors: \*Water rights, \*Wyoming, \*Judicial decisions, Appropriation, Remedies, Jurisdiction, Water law, Water allocation(Policy), Water policy, Legal aspects.

An appropriate water right is an exclusive right to use water appropriated according to the law and applied to a beneficial use. Suits to protect these rights have taken many different forms in Wyoming: (1) actions seeking quiet title relief; (2) declaratory judgments; (3) damages; (4) injunctions to prevent wrongful diversions; (5) writs of mandamus; and (6) mandatory and preventive injunctions against water officials. Of course, relief requested by some plaintiffs includes a combination of these different remedies. Procedural problems relating to jurisdiction, parties, pleadings, and forms of relief which arise in water disputes are examined. For jurisdiction, the issues of power, competence and venue, and primary jurisdiction are considered. Considered as parties to suits are water officials and water distribution agencies. The unique nature of an appropriate water right causes a number of procedural problems, when a suit to protect such rights is forced into forms of action designed to protect different kinds of rights and property. (Walker-Florida)  
W80-03411

**U.S. CORPORATE RESPONSE TO ENVIRONMENTAL OBJECTIVES.**  
Environmental Protection Agency, Chicago, IL.  
Enforcement Div.  
J. O. McDonald.  
Earth Law Journal, Vol 3, Issues 1-4, p 156-163, 1977.

Descriptors: \*Federal Water Pollution Control Act, \*Water quality standards, \*Water pollution control, Permits, Legislation, Environment, Effluents, Penalties(Legal).

The major problem with past pollution legislation has been lack of specificity. The 1972 Federal Water Pollution Control Act Amendments were

badly needed. They have far reaching results for industry, government and the public. The National Pollutant Discharge Elimination System (NPDES) program is a major new source of regulation. This is a permit program based on effluent requirements. Schedules for control of effluent are also included. The program calls for state-federal implementation and enforcement. The permit is treated as if it were a contract. The past laissez-faire arrangement between polluters and administrators is gone. Penalties include fines of \$25,000 per day and one year in jail for the first offense and \$50,000 in fines and two years in jail for subsequent offenses. A major effort is needed to increase public awareness of pollution control and clean-up legislation. These amendments may accomplish this, as they provide for citizen suits and the awarding of court costs and attorney fees to either side. (Walker-Florida)  
W80-03412

**WATER RESOURCES COMMITTEE REPORT ON WATER LAW DEVELOPMENTS.**  
American Bar Association, Washington, DC.  
Natural Resources Lawyer, Vol 6, No 3, p 439-471, Summer 1973.

Descriptors: \*Water law, \*Administration, \*Legislation, \*Judicial decisions, State governments, Legal aspects, Water policy, Water management(Appplied), Water rights, Watercourses(Legal aspects).

Summarized are significant developments in the field of water law and water administration in the United States for the period from August 15, 1972 to March 15, 1973. The information is presented on a state by state basis. Each summary pertains to legislative, judicial and administrative matters, as appropriate. The information was prepared by a Water Resources Committee member designated in each state. States for which there was no significant developments within the time period include: New Hampshire, Arizona, Wisconsin, North Carolina, North Dakota, Oregon, New Mexico and New York. (Walker-Florida)  
W80-03413

**UNITED STATES OCEAN MINERAL RESOURCE INTERESTS AND THE UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA.**  
Department of the Interior, Washington, DC.  
Office of the Assistant Secretary for Energy and Minerals.  
L. S. Ratiner, and R. L. Wright.  
Natural Resources Lawyer, Vol 6, No 1, p 1-43, Winter 1973.

Descriptors: \*Law of the Sea, \*Resources development, \*International waters, Mining, Oil, Mineral industry, Industries, Legislation, United Nations, United States.

An overview is presented of the challenges facing negotiators at the third United Nations Conference (Conference) on the Law of the Sea. Reference is made to previous conferences and their results. Major emphasis is placed on the effect that the third conference is likely to have on the distribution of ocean mineral resources. This problem is divided into the two categories of petroleum and hard minerals. For each of these resources the following are considered: (1) U.S. interest in the resource; (2) U.S. position; (3) other countries' interests in the resource; and (4) progress of the negotiations. Until a final treaty is adopted, the mining industry suggests that interim deep sea mining legislation be passed. The industry's arguments are: (1) The United States (U.S.) should develop a politically secure source of important metals; (2) Ocean mining will lead to new important technology; (3) Deep sea mining will improve U.S. balance of payments; (4) Treaty negotiations are slow and unlikely to produce reasonable results; (5) The U.S. is using deep sea mining as a trading coin to achieve other objectives in the conference; and (6) Deep sea interim legislation will help achieve an international regime and organization. (Walker-Florida)  
W80-03415

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

#### THE NATIONAL ESTUARINE SANCTUARY PROGRAM

National Oceanic and Atmospheric Administration, Washington, DC.

J. W. MacFarland, and R. S. Weinstein.

Coastal Zone Management Journal, Vol 6, No 1, p 89-97, 1979. 12 Ref, 1 Append.

Descriptors: \*Estuarine environment, \*Marsh management, \*Coastal marshes, Coasts, Estuaries, Ecosystems, Federal government, Management, Environmental effects, Grants.

In the 1972 Coastal Zone Management Act Congress established the Estuarine Sanctuary Program. This program arose in response to two government studies showing that estuaries are economically and ecologically valuable to man and in danger of being physically altered and polluted. The program makes available a fifty-percent matching grant to coastal states to help them set aside estuarine areas for research and education. The information gained within these areas will aid in future management decisions concerning the coastal zone. The sanctuaries are established and operated under the Estuarine Sanctuary Guidelines. Grants are available for preacquisition, acquisition, and operations. Presently, there are five sanctuaries in operation, with others in the planning stage. The five established sanctuaries are in South Slough, Oregon, Sapelo Island, Georgia, Wainance Hawaii; Old Woman Creek, Ohio; and Rookery Bay, Florida. Proposed sites are in Apalachicola Bay/River, Florida and Elkhorn Slough, California. A reference list is included. (Walker-Florida) W80-03416

#### ADVERSE EFFECTS OF RECREATION ON SAND DUNES: A PROBLEM FOR COASTAL ZONE MANAGEMENT

Environmental Research Associates, Seattle, WA. G. Vogt.

Coastal Zone Management Journal, Vol 6, No 3, p 37-68, 1979. 3 Fig, 60 Ref.

Descriptors: \*Dune sands, \*Recreation demand, \*Carrying capacity, Coasts, Management, Dunes, Environmental effects, Land use, Shores, Coastal structures.

The conflict between two goals of coastal zone management are dealt with: preservation of and increased access to the shoreline for recreation purposes. Foot traffic and off-road vehicles are examples of recreational activities which can harm dune areas. The concepts of ecological and perceptual carrying capacity are discussed. The former deals with the environment's assimilative capability, while the latter focuses on the recreationist's perception of environmental quality. Coastal zone management policies of certain federal, state and local government entities are examined. Attention is focused on state regulations in California and Oregon with local coastal management programs in Washington state receiving mention. A two-stage methodology is proposed to aid in decision-making on the local governmental level. In the first stage, a decision must be made as to whether increasing access to the coastal zone for recreation is more or less important than protecting the coastal resource. Decision stage two deals with how the coastal resource is allocated to different recreation uses and what management tools can be used in making allocation decisions. An implementation scenario is also proposed. (Walker-Florida) W80-03417

#### DEVELOPING MANAGEMENT GUIDELINES FOR OIL AND GAS ACTIVITIES: THE LOUISIANA EXPERIENCE

Louisiana State Univ., Baton Rouge.

J. H. Stone, L. M. Bahr, Jr., J. W. Day, Jr., R. E. Turner, and P. H. Temple.

Coastal Zone Management Journal, Vol 6, No 1, p 9-35, 1979. 1 Fig, 1 Tab, 30 Ref.

Descriptors: \*Louisiana, \*Water pollution control, \*Resources development, Management, Oil industry, Coasts, Natural gas, Environmental effects, Estimating benefits, Estimating costs.

Preliminary management guidelines have been derived for oil and gas activities in coastal Louisiana. Passage of the federal Coastal Zone Management Act resulted in a planning program to develop a Coastal Zone Management Plan for Louisiana. A general premise was that all economic activities should be designed to complement natural functions as much as possible. The process by which the guidelines for the oil and gas industry were established is analyzed. A step-by-step method is described as follows: (1) agree that there are environmental impacts; (2) estimate the extent of the impacts; (3) establish guidelines to deal with the impacts; (4) solve technical problems associated with guidelines; (5) transfer and implement procedures or guidelines; and (6) enforce the guidelines. Included with this process analysis is a discussion of the implications for coastal zone management. A series of tables outlines the coastline impacts of activities relating to oil and gas exploration, construction, production and ancillary development. Guidelines are listed to reduce these impacts and their unknown effects. (Walker-Florida) W80-03418

#### NATIONALIZING LAKE TAHOE

Santa Clara Law Review, Vol 19, No 3, p 681-717, Summer 1979.

Descriptors: \*Federal government, \*Land management, \*California, \*Nevada, Administrative agencies, Basins, Urbanization, Planning, State governments, Land use, Recreation.

As a result of urbanization in the Northern California and Northwestern Nevada area, concern arose for the preservation of the Lake Tahoe Basin area as a beautiful recreation attraction. In response to this concern, a planning board, the Tahoe Regional Planning Agency (TRPA), was created pursuant to an agreement between California and Nevada with Congressional approval. Recently, the TRPA's effectiveness has been questioned. Any resolution of the problem has been stymied due to the disagreement between the two states' legislatures. Federal intervention has been threatened to resolve the dispute. Various methods of federal intervention are examined. The creation of a national recreation area is stressed with the imposition of federal land use controls as a means to protect the basin, in the absence of effective state land management controls. There is a wealth of federal power available to affect the area's growth. Apparently, Congress has the constitutional power to impose direct federal land use control to protect any federal land. At the very least, a congressional declaration of the national interest in Lake Tahoe should be made. (Quarles-Florida) W80-03419

#### SOUTH DAKOTA GROUND WATER AND THE ARTESIAN PRESSURE: IS THE USE OF WATER FOR DOMESTIC PURPOSES STILL THE HIGHEST USE?

G. L. Peterson.

South Dakota Law Review, Vol 24, No 3, p 772-794, Summer 1979.

Descriptors: \*South Dakota, \*Domestic water, \*Artesian wells, Constitutional law, Groundwater availability, Compensation, Water law, Groundwater resources, Water demand.

Before 1972 it was South Dakota's policy to protect the artesian pressure as a means of diversion of ground waters. A 1972 amendment to the state's water law changed this policy. As a result of a priority dispute over the use of the artesian pressure, the amended statute tips the balance in favor of the large-scale user and away from the domestic user. The framework of a constitutional challenge is analyzed. The assertion is that valuable property rights to the beneficial use of the water have been taken without compensation. An examination of alternative theories that a domestic user may argue in asserting his right to the artesian pressure is also presented. Common law theories such as nuisance and negligence may be argued, but a more feasible approach would be to advocate a statutory change. Domestic wells should be regulated to phase out 'freeloading', archaic wells. A statutory definition

of adequacy more common to the average layman should be provided, taking into account existing wells and the state of development in the area. (Walker-Florida) W80-03420

#### THE GROWING NEED FOR FEDERAL-STATE COOPERATION IN MANAGING THE SEA

Marine Mammal Commission, Washington, DC. D. Laist, and J. Epting.

Coastal Zone Management Journal, Vol 6, No 1, p 1-7, 1979.

Descriptors: \*State governments, \*Oceans, \*Regulation, \*Governmental interrelations, Submerged Lands Act, Coasts, Jurisdiction, Water resources, Coordination, Management.

As the number of federal marine management programs and authorities proliferates, at least two concerns become immediately apparent. First, the separate pieces of enabling legislation for these programs do not combine into a cohesive whole. They are a series of piecemeal initiatives each defining a specific, though often overlapping, marine mission. This creates the problems of inefficient work and bureaucratic tracking of progress within other programs. Several studies are referred to which investigate the need for a more comprehensive and integrated national ocean management system. The second concern is the recognition of the current and essential state role in marine management. This arises because the three-mile limit controlled by the states contains a major segment of the overall marine resources. The states also control the condition of the environmentally sensitive estuarine and near-shore environments. The states have been given broad federal mandates under the Submerged Lands Act and the Coastal Zone Management Act. For these reasons, a more viable state role in marine management is advocated. (Walker-Florida) W80-03421

#### SAFEGUARDS FOR GROUNDWATER

J. Josephson.

Environmental Science and Technology, Vol 14, No 1, p 38-44, January, 1980. 2 Fig.

Descriptors: \*Water pollution control, \*Groundwater, \*Regulations, Landfills, Injection wells, Impoundments, Pollutants, Wastes, Monitoring, Sampling, Attenuation.

Approximately 50% of the U.S. population depends upon ground water. Due to its slow movement and lack of oxygen, ground water tends to be a contaminant preservation medium. Contaminant mobility depends upon oxidation-reduction potentials, complementary ions, and the presence of clays. Contaminants can be contained or intercepted by pumping but this will require treatment of pumped ground water or discharge of untreated ground water. The best approach to ground water protection would be to prevent contamination due to improper land-filling, underground injection, and surface impounding of hazardous wastes. The EPA acting under the Safe Drinking Water Act of 1974 (SDWA) and the Resource Conservation and Recovery Act of 1976 (RCRA) will enforce strict regulations governing disposal of wastes. This will affect 275,000 waste generators, 30,000 facilities, and about 10,000 waste transporters. In addition there will be rules, guidelines and recommendations for monitoring ground water. For example, sampling must avoid contact with atmospheric air and the monitoring/sampling equipment should not react with the suspected contaminants. Analyses performed by an EPA-certified laboratory would have greater credibility in a dispute. (Purdin-NWVA) W80-03422

#### EXECUTIVE SUMMARY OF THE REPORT "SURFACE IMPOUNDMENTS AND THE EFFECTS OF GROUND WATER QUALITY IN THE UNITED STATES—A PRELIMINARY SURVEY"

Geraghty and Miller, Inc., Tampa, FL.

For primary bibliographic entry see Field 5B.

## Ecologic Impact Of Water Development—Group 6G

W80-03424

**EPA'S HAZARDOUS-WASTE PROGRAM: WILL IT SAVE OUR GROUND WATER?**  
For primary bibliographic entry see Field 5E.  
W80-03431

**DAM SAFETY: THE CRITICAL IMPERATIVE,**  
Western New England Coll., Springfield, MA.  
D. Binder.  
Land and Water Law Review, Vol 14, No 2, p 341-392, 1979.

Descriptors: \*Dam failure, \*Safety factors, \*Dam construction, Dams, Governmental interpretation, Federal-State-Water rights conflicts, Legislation, Administrative agencies, Interstate rivers, Dam sites, Inspection.

The Carter administration is conducting a major reappraisal of Western water policy. A crucial area of consideration will be dam safety. The spectacular Teton dam break has been the most dramatic example of the seriousness of the dam safety problem. It was, however, only the culmination of a series of breaks and near-misses which have swept away congressional inaction. The result has been the Federal Dam Safety Inspection Act. This Act, proposed model codes, and existing state regulation are examined. The Teton disaster, its causes and lessons are also examined. States must enforce minimum safety and inspection standards. Present state programs are grossly inadequate. Because dams involve interstate waters and the present state regulations are inadequate a federal agency is proposed. (Mac Gregor-Florida)  
W80-03499

**THE THIRD UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA: THE SEVENTH SESSION (1978),**  
Miami Univ., FL. School of Law.  
B. H. Oxman.  
American Journal of International Law, Vol 73, No 1, p 1-41, January 1979.

Descriptors: \*International law, \*Law of the sea, \*United Nations, \*International waters, United States, Water law, Negotiations, Continental shelf, Oceans, Treaties.

The seventh session of the Third United Nations Conference on the Law of the Sea met in Geneva and New York during 1978. Most of the Informal Composite Negotiating Text (ICNT), except for part XI relating to deep seabed mining, survived without further amendments. Aside from the deep seabed issues, there was no general disagreement on basic substantive questions. The United States along with other potential seabed mining countries rejected Part XI of the ICNT. Seven negotiating groups on outstanding issues were appointed at the session. Three groups dealt with deep seabed matters: the first, with the system of exploration and exploitation and resource policy; the second, with financial arrangements; and the third, with organs of the Seabed Authority. The fourth negotiating group dealt with access to living resources of the economic zone by landlocked states. The fifth group dealt with the settlement of disputes over fisheries in the economic zone. The sixth group attempted to define the outer limits of the continental shelf. The final group examined the delimitation of maritime boundaries between adjacent and opposite states and the settlement of delimitation disputes. (Quarles-Florida)  
W80-03500

**TIDELANDS AND THE PUBLIC TRUST: AN APPLICATION FOR SOUTH CAROLINA,**  
B. W. Wyche.  
Ecology Law Quarterly, Vol 7, p 137-170, 1978.

Descriptors: \*Tidal marshes, \*South Carolina, \*Court decisions, Wetlands, Land use, Marshes, Judicial decisions, Public rights, Water law.

Courts have generally applied the public trust doctrine to tidelands. Under the doctrine, tidelands, as

well as lands underlying navigable, non-tidal waters, are held in trust for the benefit of the public. The owner is deemed to hold his title subject to the paramount rights of the public in the lands. In *State v. Hardee* (South Carolina), Justice Bussey of the South Carolina Supreme Court concurred with the result reached in the majority decision, but concluded in a separate opinion that only submerged lands are held in the public trust; the tidelands are merely 'vacant lots subject to grant and private ownership as any other vacant lands'. The main purpose of this article is to re-examine the conclusions drawn by Justice Bussey and others. By analyzing the common law, South Carolina statutory and case law, and the law in other jurisdictions, this article seeks to demonstrate that a tidelands trust does exist in the state. (Steiner-Mass)  
W80-03526

**INTEGRATED PLANNING FOR WATER QUALITY MANAGEMENT: THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972 AND COASTAL ZONE MANAGEMENT,**  
Cornell Univ., Ithaca, NY. Dept. of City and Regional Planning.  
W. K. Allayaud.  
January 1979. 217 p, 55 Ref.

Descriptors: \*Coastal zone management, \*Federal Water Pollution Control Act Amendments, \*Water quality, \*Federal Coastal Zone Management Act, \*Planning, \*Water quality control, \*Governmental interrelations, Management, Implementation, Land planning, Water management (Applied), Water permits, Water resources planning, Legislation.

The Federal Water Pollution Control Act Amendments were enacted by Congress in response to the severe water quality problems being faced by the nation. In addition to creating a permit system for dischargers and ordering grants for construction of sewage treatment plants, the Amendments place planning in a crucial role in the long-term effort to clean our waters. Section 208 of the Amendments establishes regional planning for water quality management as being necessary and provides strong incentives for states and municipalities to implement the Section's requirements. The Federal Coastal Zone Management Act of 1972 acknowledges the need to relate air, land and water planning in the coastal zones and gives the states the lead in order to provide comprehensive, coordinated management of coastal areas. These two processes—Section 208 and the Coastal Zone Management Act (CSMA)—need to be coordinated during implementation and the final planning outputs need to be integrated. There are five issues which relate to this integration. The first two issues on land and water planning integration and the role of different government levels are more general. The other three issues—coordination and integration of planning processes, sewage disposal in the coastal zone, and the 208 plan—deal more specifically with how the two planning processes come together. The author recommends that the states should play the lead role in the integration of water and land planning and they should also assume a stronger role in the system of federalism for resource management. Another major recommendation is that a final decision on ocean disposal of sewage should be postponed while continued planning helps to clarify the situation. Two case studies are presented. (Iervolino-NC)  
W80-03581

**THE CANADA WATER ACT ANNUAL REPORT, 1978-1979.**  
Department of the Environment, Ottawa (Ontario).  
1979. 32 p.

Descriptors: \*Water quality, \*Water management (Administrative), \*Flood damage reduction, \*Basin studies, \*Canada Water Act, \*Water resources, \*Water policy, \*Legislation, Governments, Flood plain management, Basins, Nutrient loading, Watershed management, Hydrologic data, Flood-risk mapping, Flood protection,

Monitoring, Flood damage, Water resources planning.

This is the seventh annual report covering operations to March 31, 1979. It outlines provisions of the 1970 Canada Water Act and discusses various government programs designed to carry out those provisions. Comprehensive water resource management included five major programs begun in 1970-1978 and implemented throughout 1978-1979. The flood damage reduction program identifies flood risks and potential damage in flood-prone areas, partially through an ongoing flood risk mapping effort. Construction activities included a dyking program in Southwestern Ontario and the Okanagan Flood Control Channel in British Columbia. Research activities pursuant to the Canada-Ontario Agreement on Great Lakes Water Quality also continued. The number of detected violations of nutrient loading limitations have declined since 1973. Public information programs included shoreline protection/flood hazard manuals, new data in the 1979 Canada Water Year Book, and television broadcasts on the flood damage reduction program. A description of the recent drought in Western Canada is presented. Eight implementation agreements on conducting of water basin agreements were reached and seven planning studies begun. (Arnold-NC)  
W80-03583

## 6F. Nonstructural Alternatives

## NATIONALIZING LAKE TAHOE.

For primary bibliographic entry see Field 6E.  
W80-03419

**TYPE 16 FLOOD INSURANCE STUDY: TSUNAMI PREDICTIONS FOR THE WEST COAST OF THE CONTINENTAL UNITED STATES,**  
Army Engineer Waterways Experiment Station, Vicksburg, MS.  
For primary bibliographic entry see Field 2E.  
W80-03556

## 6G. Ecologic Impact Of Water Development

**WATERFOWL PAIR USE OF NATURAL AND MAN-MADE WETLANDS IN SOUTH DAKOTA,**  
South Dakota State Univ., Brookings. Dept. of Wildlife and Fisheries.  
J. J. Ruwaldt, Jr., L. D. Flake, and J. M. Gates.  
Journal of Wildlife Management, Vol 43, No 2, p 375-383, April, 1979. 5 Tab, 22 Ref. OWRT A-038-SDAK(2), B-045-SDAK(2).

Descriptors: \*Waterfowl, \*Breeding, \*Grasslands, \*Potholes, Water levels, Water fluctuation, Blue-winged teal, Pintail ducks, Shoveler duck, Ponding, Wetlands, Freshwater marshes, Ecology, Ponds, Lakes, \*South Dakota.

Prairie ponds and lakes, primarily of glacial origin, comprised 75 and 68%, respectively, of the total area and number of wetlands in South Dakota. Stock ponds comprised 14% of the area and 21% of the wetlands, and dugouts 1% and 12% of the wetland area and numbers, respectively. Semipermanent wetlands and stock ponds contained proportionally more pairs of most species than other wetland categories. Ephemeral, temporary, and seasonal wetlands were also heavily utilized by pairs, but contained smaller proportions of total pairs than semipermanent wetlands because of smaller surface water area. Permanent lakes received relatively low use in relation to surface water area. Ephemeral, temporary, and seasonal wetlands were part of a wetland complex utilized by Anatini. For several species of Anatini, loss of a portion of that complex as a result of drought apparently caused reduced pair use of the remaining semipermanent wetlands as well as stock ponds and dugouts. (Howard-Mass)  
W80-03441

## Field 6—WATER RESOURCES PLANNING

### Group 6G—Ecologic Impact Of Water Development

**THE EFFECTS OF WATERFOWL MANAGEMENT PRACTICES ON MOSQUITO ABUNDANCE AND DISTRIBUTION IN LOUISIANA COASTAL MARSHES.**  
Louisiana State Univ., Baton Rouge.  
S. C. Fleetwood, C. D. Steelman, and P. E. Schilling.  
Mosquito News, Vol 38, No 1, p 105-111, March, 1978. 2 Fig, 3 Tab, 12 Ref.

Descriptors: \*Salt marshes, \*Marsh management, \*Waterfowl, \*Environmental effects, \*Mosquitoes, Impoundments, Ecological distribution, Life history studies, Habitat, Insects, Wetlands, Wildlife management, Louisiana, Ecology.

Waterfowl management practices utilized in intermediate and brackish marsh impoundments produce significantly (P less than 0.01) more mosquitoes than practices utilized in marsh pump-outs or natural salt marsh in Louisiana. During the time that the impoundments were flooded, the intermediate marsh impoundment produced significantly (P less than 0.01) larger numbers of mosquitoes than the brackish marsh impoundment. *Culex salinarius* preferred the intermediate marsh impoundment. *Anopheles bradleyi* preferred the brackish marsh impoundment. During the time that the impoundments were drained (May through September), *Aedes sollicitans* eggs were collected in significantly larger numbers from the intermediate marsh impoundment. (Howard-Mass)  
W80-03511

**ASSESSMENT OF EFFECTS OF ALTERED STREAM FLOW CHARACTERISTICS ON FISH AND WILDLIFE. PART B: CALIFORNIA, CASE STUDIES.**  
Jones and Stokes, Inc., Sacramento, CA.  
C. Hazel, S. Herrera, H. Rectenwald, and J. Ives.  
U.S. Fish and Wildlife Service, Office of Biological Service Report FWS/OBS-76/34. December, 1976. 606 p, 1 Append.

Descriptors: \*California, \*Wildlife habitat, \*Water resources development, \*Streamflow, Wildlife, Dams, Alteration of flow, Fisheries, Water resources, Fish management.

The results and conclusions are given for 47 case studies of California water projects that altered natural streamflow regimes and causally affected the fish and wildlife. Surveys were conducted on existing conditions below dams and diversions to assess the actual effects of the streamflow characteristics on fish and wildlife and to evaluate the adequacy of the methodologies used to determine necessary flows. (Steiner-Mass)  
W80-03517

## 7. RESOURCES DATA

### 7A. Network Design

**HYDROMETEOROLOGICAL MODEL FOR STREAMFLOW PREDICTION.**  
Geological Survey, Tacoma, WA. Water Resources Div.  
For primary bibliographic entry see Field 2A.  
W80-03487

### 7B. Data Acquisition

**AN AUTOMATIC RANGE-SWITCHING MODIFICATION FOR DIRECT-READING SPECIFIC CONDUCTANCE MEASUREMENTS.**  
Geological Survey, Denver, CO. Water Resources Div.  
H. E. Taylor, and D. E. Erdmann.  
Chemical, Biomedical, and Environmental Instrumentation, Vol 9, No 1, p 49-60, 1979. 4 Fig, 1 Tab, 13 Ref.

Descriptors: \*Automation, \*Specific conductivity, \*Measurement, \*Instrumentation, Analytical techniques, Water sampling, \*Automatic range-switching modification, Digital electronic circuitry, Direct-reading conductivity meter.

An analysis system was developed to determine automatically specific conductance on samples at the rate of 30 per hour over a range of 1 to 15,000 micromho per centimeter with a precision of 1 percent or less. The system consists of custom-designed digital electronic circuitry which modifies a commercially available direct-reading conductivity meter. This modification permits automatic range switching of the meter so that measurements are made under optimum conditions. (Kosco-USGS)  
W80-03328

**HYDROLOGIC LAND USE CLASSIFICATION USING LANDSAT.**  
Hydrologic Engineering Center, Davis, CA.  
R. J. Cermak, A. D. Feldman, and R. P. Webb.  
Technical Paper No 67, October 1979. 24 p, 5 Fig, 3 Tab, 8 Ref.

Descriptors: \*Land classification, \*Remote sensing, \*Hydrology, \*Satellites(Artificial), Land use, Hydrologic aspects, Watersheds(Basins), Runoff, Agriculture, Vegetation, Pasture, Industries, Water, Discharge(Water), Hydrographs, LANDSAT, Residential.

This report described the Hydrologic Engineering Center's experience with land use classification from LANDSAT multispectral imagery. Land use is required for the estimation of hydrologic model parameters. The land use classification procedure used, developed at the University of California, Davis, for the Corps of Engineers, is an unsupervised, noninteractive approach requiring no special image processing equipment. Watershed land use was determined from LANDSAT digital data, entered into a geographic data bank, and compared with a conventional land use classification. Hydrologic simulation model parameters were estimated from land use and other basin characteristics. The generated discharge frequency curves, corresponding to the alternative land use classifications, permitted the hydrologic significance of accuracy in land use identification to be assessed. (Humphreys-ISWS)  
W80-03347

**TV CAMERA LETS YOU LOOK DOWN A WELL.**  
C. Henry.  
Irrigation Age, Vol 14, No 4, p 36-37, 45, January, 1980.

Descriptors: \*Borehole cameras, \*Irrigation wells, Logging(Recording), Photography, Remote sensing, Repairing.

Monitoring of irrigation wells with a downhole TV camera can quickly determine the cause of lost production or decreased flow and the best way to repair a well or fish for lost tools. It is also used by drillers to assure their customers that a new well was completed correctly, and by homeowners who want to convince prospective buyers that an old well is in good condition. With a black and white system a single conductor on a 1/4 in. line handles both camera and light source. The equipment can go as deep as 1700 ft. and withstand 200F water and artesian heads up to 2000 gpm. The picture transmitted from the well is a complete 360 degree view of the hole at about a 45 degree angle. A video tape of the well with a running commentary is made as the camera descends. Taping a normal well will cost between \$250 and \$500. (Purdin-NWWA)  
W80-03423

**DOWSING ACHIEVES NEW CREDENCE.**  
T. Williamson.  
New Scientist, p 371-373, February 8, 1979. 1 Fig, 7 Ref.

Descriptors: \*Groundwater, \*Minerology, \*Exploration, Magnetic studies, Geophysics, Structural geology, Remote sensing, Subsurface investigations.

A new method for mineral and ground water exploration, called the bio-physical method (BPM)

in the Soviet Union or more commonly known as dowsing or dowsing, is being seriously investigated by some scientists. Hydrogeologists and other scientists concerned with ground water supplies have traditionally viewed water divining with distaste or hostility. This is due to the fact that most water diviners do not have even a basic understanding of ground water geology and perpetuate naive and unscientific theories about ground water and dowsing. Soviet geologists have been studying BPM for 12 years and have gotten as good or better results than obtained from geophysical methods. They theorize that the human nervous system is sensitive to very small anomalies in magnetic field strength caused by geologic discontinuities (faults, buried valleys, solution cavities, etc.). Mineral veins and ground water are often localized in such discontinuities. If the underlying principles of BPM were discovered, a simple, inexpensive water prospecting tool would be available to developing countries that depend on ground water. What is required is a thorough scientific investigation by a multidisciplinary team. (Purdin-NWWA)  
W80-03432

**MODEL FOR ESTIMATING ELECTRIC MACROANISOTROPY COEFFICIENT OF AQUIFERS WITH HORIZONTAL AND VERTICAL FRACTURES.**  
Geological Survey, Denver, CO.  
For primary bibliographic entry see Field 2F.  
W80-03434

**A HYDROLOGICAL ANALYSIS OF EAST AUSTRALIAN FLOODS USING NIMBUS-5 ELECTRICALLY SCANNING RADIOMETER DATA.**  
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.  
L. J. Allison, T. J. Schmugge, and G. Byrne.  
Bulletin of the American Meteorological Society, Vol 60, No 12, p 1414-1427, December 1979. 13 Fig, 40 Ref.

Descriptors: \*Rainfall, \*Floods, \*Australia, \*Remote sensing, Satellites(Artificial), Rivers, Watersheds(Basins), Soils, Soil moisture, Microwaves, Runoff, Drainage, Hydrology, Meteorology, Microwave brightness temperatures, Scanning microwave radiometers.

The chronological development and diminution of six floods in eastern Australia during January, February, and March 1974 were mapped for the first time by the Nimbus Electrically Scanning Microwave Radiometer (ESMR). Day and nighttime ESMR (19.35 GHz) coverage was analyzed for the low gradient, flooded Darling River system in New South Wales. Apparent movement of surface water as indicated by low brightness temperatures (less than 250 K, day and less than 240 K, night) was easily followed around the curved runoff basin along the northern shoreline of the flooded Darling River during this 3-month period. This pattern was in good agreement with flood crest data at selected river height gauge stations, even under cloudy conditions. (Sims-ISWS)  
W80-03474

**A DISTANT READING RAINGAUGE.**  
Meteorological Office, Poona (India). Instruments Div.  
N. V. Iyer.  
Mausam, Vol 30, No 1, p 55-58, January 1979. 4 Fig, 1 Tab, 2 Ref.

Descriptors: \*Remote sensing, \*Rain gages, \*Rainfall, Instrumentation, Flood forecasting, Flood control, Electronic equipment, Rainfall intensity, \*Rainfall counter, \*Instruments, Field testing, Hydrometeorological stations, Flood warning, Sensor, Electronic counter, Rainfall rate.

A remote indicating rainfall counter was designed, constructed, and field tested in the Instruments Division of the Pune Meteorological Office. The sensor used was a conventional tipping bucket rain gage connected to a counter housed inside the observatory office. The instrument can be useful in flood forecasting offices, hydrometeorological stations, and airport meteorological offices. The total

Evaluation, Processing and Publication—Group 7C

rainfall can be read off easily on the counter and the rate of rainfall determined by using a stopwatch during heavy periods of rain. A magnet attached to the tipping bucket moves past a reed switch to make an electrical contact for each tilt of the bucket. The contacts are conveyed by cable to an electronic counter made up of integrated circuits. Light-emitting diodes display the rainfall registered by the counter. The performance of the instrument was good when some of its limiting factors—such as a 1-mm least count and time lost during tipping the bucket plus friction—were taken into consideration. (Roberts-ISWS) W80-03476

**TREE RINGS AS INDICATORS OF HYDROLOGIC CHANGE IN THE GREAT DISMAL SWAMP, VIRGINIA AND NORTH CAROLINA,** Geological Survey, Reston, VA. Water Resources Div. R. L. Phipps, D. L. Ireley, and C. P. Baker. Available from the National Technical Information Service, Springfield, VA 22161 as PB-301 385. Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-136, 1979. 26 p, 5 Fig, 5 Tab, 17 Ref.

Descriptors: \*Dendrochronology, \*Hydrology, \*Variability, \*Swamps, Virginia, North Carolina, Model studies, Analytical techniques, Data collections, Loblolly pine trees, Sampling, Drainage, Climatic data, Regression analysis, Documentation, Precipitation (Atmospheric), Temperature, Water levels, Sites, \*Great Dismal Swamp (VA-NC), Predicting, Postditching, Tree rings, Hydrologic change indicators.

Analysis of tree rings of large, canopy loblolly pines (*Pinus taeda* L.) growing near a drainage ditch in the Great Dismal Swamp have indicated that the tree rings are datable and hydrologically (climatically) sensitive. Climatic and prior growth factors in regression explained 87 and 71 percent of the variance of the preditching and postditching earlywood widths, respectively, and 82 and 70 percent of the latewood widths for the same time periods. Early summer precipitation was significantly, and positively correlated with preditching latewood growth. When preditching and postditching records were merged into a single record, regression analysis explained less growth variation than when the two time periods were considered individually, implying a change in growth response following ditching. Prior to ditching, growth was most limited by dry summers which followed dry summers. After ditching, growth was less strongly linked with precipitation and more strongly linked with temperature. Regression results are compatible with the contention that growing season water levels in the proximity of the collection site have been lower since ditching. (Kosco-USGS) W80-03490

**SOME IMPLICATIONS OF REMOTE SENSING TECHNOLOGY IN INSECT CONTROL PROGRAMS INCLUDING MOSQUITOES,** National Aeronautics and Space Administration, Houston, TX. Lyndon B. Johnson Space Center. C. M. Barnes, and W. C. Cibula. Mosquito News, Vol 39, No 2, p 271-282, June, 1979. 8 Fig, 16 Ref.

Descriptors: \*Wetlands, \*Remote sensing, \*Vegetation, \*Classification, Terrain analysis, Aerial photography, Photogrammetry, Research and development, Public health, Insects, Aquatic insects, Habitat.

Preliminary investigative work is described concerning the application of remote sensing technology to the classification of wetland vegetation and terrain which have implied public health and insect control significance. Initial activity concerned definition of mosquito breeding habitat using multi-brand aerial photography, and multispectral sensing from aircraft. Photography is the least expensive remote sensing system yet both methods do an excellent job of defining environment and vegetative habitat. It appears feasible to utilize LANDSAT satellite imagery to classify into broad ecotypes the vegetation sometimes associated with

insect development. Research has been limited to one mosquito species, but it seems likely that other species may be studied using similar techniques. (Howard-Mass) W80-03514

**MOVEMENT OF SUSPENDED PARTICLES AND SOLUTE CONCENTRATIONS WITH INFLOW AND TIDAL ACTION,** Army Engineer Waterways Experiment Station, Vicksburg, MS. For primary bibliographic entry see Field 2L. W80-03564

7C. Evaluation, Processing and Publication

**DELINEATION OF BURIED RIVER VALLEY AQUIFERS IN DISSECTED TILL PLAINS,** Missouri Univ. Columbia. Dept. of Geology. J. M. Sharp, Jr., M. D. Hall, M. Bahorich, and C. Keefe. Available from the National Technical Information Service, Springfield, VA 22161 as PB80-143621. Price codes: A04 in paper copy, A01 in microfiche. Missouri Water Resources Research Center, University of Missouri Completion Report. November 1979. 51 p, 29 Fig, 24 Ref, 2 Append, OWRT A-112-MO (1), 14-34-001-9027.

Descriptors: \*Subsurface mapping, \*Bedrock, \*Aquifers, Valleys, Glacial drift, Till, Geomorphology, Missouri, Iowa, \*Buried River Valley aquifers, Gravity profile.

Several methods of gravity geophysics, in conjunction with drift thickness and bedrock topography maps, were used to map the location of buried river valleys in northwestern Missouri. Drift thickness varies from zero to over 100 metres within the selected study area. The buried valleys are often filled with thick sequences of glacial-fluvial deposits which can serve as important aquifers. Over 900 gravimeter readings established a grid network over the study area. Two methods were used to calculate the regional Bouguer free-air anomaly-poly-nomial trend surfaces of reduced gravity readings and trend surfaces defined solely by the well data. The fifth-order polynomial trend surface closely matched basement rock topography. This trend surface, along with the gravity residual and drift thickness maps, can then be used to delineate these valleys with fair accuracy. Gravity profiles were run normal to several suspected buried valleys. The gravity residual profiles showed a strong correlation to bedrock topography, where known, and to several theoretical models. Gravity profiling can be used to delineate the deepest portion of these valleys. In all cases, an adequate density contrast was observed between the drift and the bedrock. Several promising branch aquifers, previously unreported, are indicated. W80-03302

**USE OF SYNOGRAPHIC TECHNIQUES IN RESEARCH AND DISSEMINATION OF HYDROLOGICAL INFORMATION,** Texas Univ. at Houston. School of Public Health. I. Cech, E. M. Davis, E. A. Gonzales, and D. Brooks. Water Resources Bulletin, Vol 15, No 6, p 1691-1706, December 1979. 9 Fig, 11 Ref.

Descriptors: \*Mapping, \*Data processing, \*Analytical techniques, \*Urban runoff, \*Water quality, Floods, Water pollution, Pollutants, Nutrients, Nitrogen, Nitrates, Phosphorus, Sodium, Chlorophyll, Bacteria, Groundwater, Estuaries, Water supply, \*Houston (TX), Synographic mapping.

Application of synographic techniques to four separate unrelated research tasks demonstrated the usefulness of such an approach in interpreting and communicating hydrologic survey data especially when large geographic areas are involved. Nutrient exchange and biotic indicators in coastal estuaries were analyzed to determine residence times in different seasons of the year. Man-induced changes in urban runoff patterns were shown to increase

the probability of flooding with different occurrences of storm events. Nitrate and indicator bacteria in private wells were analyzed on a county-wide basis to determine the sources and extent of natural occurrence vs. contamination origins. Water wells and the surface supply of metropolitan Houston were analyzed for sodium content to assist citizens and physicians with data that are needed for derivation of sodium-restricted therapeutic diets. (Sims-ISWS) W80-03360

**GEOHERMAL WELL DRILLING ESTIMATES BASED ON PAST WELL COSTS,** Department of Energy, Idaho Falls, ID. Idaho Operations Office. For primary bibliographic entry see Field 6B. W80-03427

**ANALYTICAL STUDY OF THE OGALLALA AQUIFER IN CARSON COUNTY, TEXAS, PROJECTIONS OF SATURATED THICKNESS, VOLUME OF WATER IN STORAGE, PUMPAGE RATES, PUMPING LIFTS, AND WELL YIELDS,** Texas Dept. of Water Resources, Austin. A. E. Bell, and S. Morrison. Report 242, November 1979. 69 p, 18 Tab, 75 Ref, 24 Map.

Descriptors: \*Groundwater resources, \*Texas, \*Aquifers, \*Data collections, Groundwater, Maps, Water resources, Aquifer characteristics, Groundwater recharge, Water supply, Groundwater availability, Groundwater mining, Overdraft, Pumping, Projections, Saturated flow, \*Carson County (TX), \*Ogallala aquifer (TX), Pumping rates, Pumping lifts, Well yields.

This is one of numerous planned county studies covering the declining groundwater resource of the Ogallala aquifer in the High Plains of Texas. The report contains maps, charts, and tabulations that reflect estimates of the volume of water in storage in the Ogallala aquifer in Carson County and the projected depletion of this water supply by decade periods through the year 2020. The report also contains estimates of pumpage, pumping lifts, and other data related to current and future water use in the county. However, the report does not attempt to project that portion of the volume of water in underground storage that may be ultimately recoverable. The Ogallala aquifer in Carson County contained approximately 9.6 million acre-feet of water in 1974. Historical pumpage has exceeded 150,000 acre-feet annually, which is approximately six times the rate of natural recharge to the aquifer in the county. This overdraft is expected to continue, ultimately resulting in reduced well yields, reduced acreage irrigated, and reduced agricultural production. There is a very uneven distribution of groundwater in the county. Some areas have ample groundwater resources to support current usage through the year 2020; whereas, in other areas of the county, groundwater is currently in short supply. To obtain maximum benefits from the remaining groundwater resources, Carson County water users should implement all possible conservation measures so that the remaining groundwater supply is used in the most prudent manner possible and with the least amount of waste. (Humphreys-ISWS) W80-03451

**PROXIMITY OF PIPELINES AND STORAGE FACILITIES FOR GAS AND OIL TO MAJOR AQUIFERS IN CONNECTICUT,** Geological Survey, Hartford, CT. Water Resources Div. J. L. Rolston, J. W. Bingham, and E. H. Handman. USGS 1200 S. Eads St. Arlington VA printed copy .75, Geological Survey Miscellaneous Field Studies Map MF-981-H, 1979. 1 Sheet, 1 Ref.

Descriptors: \*Maps, \*Pipelines, \*Storage tanks, \*Connecticut, \*Water pollution sources, Oil, Gasoline, Aquifers.

A map of Connecticut, scale 1:125,000, shows locations of oil and gas pipelines and storage facilities

## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

for fuel oil, gasoline, kerosene, diesel, and aviation fuels in relation to major aquifers. Inset map shows distribution of gasoline and diesel-fuel dealers by town. (Kosco-USGS)  
W80-03479

**PROXIMITY OF AGRICULTURAL AREAS TO MAJOR AQUIFERS IN CONNECTICUT,**  
Geological Survey, Hartford, CT. Water Resources Div.  
J. W. Bingham, and A. R. Todd.  
USGS 1200 S. Eads St. Arlington, VA price \$0.75, Geological Survey Miscellaneous Field Studies Map MF-981-F, 1979. 1 Sheet, 2 Ref.

Descriptors: \*Maps, \*Water pollution sources, \*Farm wastes, \*Connecticut, \*Aquifers, Crops, Livestock, Fertilizers, Pesticides, Waste disposal, Manure storage.

A map of Connecticut, scale 1:125,000, shows locations of agricultural land, manure storage areas, and dairy farm waste lagoons, and their relation to favorable aquifers. The map also delineates distribution of crops, livestock, fertilizer use, and pesticide use by county. (Kosco-USGS)  
W80-03480

**MAP SHOWING GROUND-WATER CONDITIONS IN THE BODAWAY MESA AREA, COCONINO COUNTY, ARIZONA—1977,**  
Geological Survey, Tucson, AZ. Water Resources Div.  
C. D. Farrar.  
Geological Survey open-file report 79-1488 (WRI), September 1979. 1 Sheet, 8 Ref.

Descriptors: \*Groundwater resources, \*Maps, \*Aquifers, Water table, \*Water quality, Hydrogeology, Indian reservations, Arizona, \*Bodaway Mesa area(Ariz), Coconino County(Ariz), Navajo Indian Reservation(Ariz).

The Bodaway Mesa area includes about 800 square miles in north-central Arizona, and most of the area is in the Navajo Indian Reservation. Groundwater development has been slight; in 1977 the estimated ground-water withdrawal was less than 5 acre-feet. The Chinle Formation is the principal aquifer tapped by wells, and in places the Moenkopi Formation and the Redwall and Muav Limestones yield water to wells and springs. Water levels in the Chinle Formation are 15 to 200 feet below the land surface. The water from one well completed in the Petrified Forest Member of the Chinle Formation contained 1,210 milligrams per liter of dissolved solids; the dissolved-solids concentrations from two wells in the Shinarump Member of the Chinle were 1,000 and 1,110 milligrams per liter. Three wells penetrate the Moenkopi Formation, but only one yields water. One well obtains its water from the Redwall Limestone, and the water level is 2,200 feet below the land surface. About 60 cubic feet per second of water is discharged by springs that issue from the Redwall and Muav Limestones along the east wall of the canyon of the Little Colorado River. Information on the map includes depth to water, altitude of the water level, specific conductance, and fluoride concentrations. Scale 1:125,000. (Kosco-USGS)  
W80-03481

**HYDROLOGIC RECORDS, VERNAL WELL-FIELD AREA, CITY OF SARASOTA, FLORIDA, 1962-76—A DATA REPORT,**  
Geological Survey, Tallahassee, FL. Water Resources Div.  
H. Sutcliffe, Jr., and A. Buono.  
Available from OFSS, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225, Price codes: \$18.50 in paper copy, \$3.50 in microfiche. Geological Survey open-file report 79-1259, 1979. 141 p, 11 Fig, 13 Tab, 4 Ref.

Descriptors: \*Hydrologic data, \*Water wells, \*Florida, \*Groundwater, \*Water supply, Aquifer characteristics, Drillers logs, Water level fluctuations, Pumping, Test wells, Chemical analysis, Specific capacity, Vernal-well field area(Fla), Sarasota(Fla).

A short history of the development and operation of the Verna well field in Florida is presented. Also included are geological, drillers' and selected geophysical logs of test and production wells; chemical analyses; specific capacity tests; pumpage; physical dimensions of wells; and source for other data available as indicated. (Kosco-USGS)  
W80-03483

**CHARACTERISTICS OF FOUR URBANIZED BASINS IN SOUTH FLORIDA,**  
Geological Survey, Tallahassee, FL. Water Resources Div.  
R. A. Miller.  
Geological Survey open-file report 79-694, May 1979. 45 p, 17 Fig, 17 Tab, 9 Ref.

Descriptors: \*Watersheds(Basins), \*Urban hydrology, \*Urban runoff, \*Hydrologic data, \*Florida, Model studies, Rainfall-runoff relationships, Storm runoff, Data collections, \*South Florida.

Physical characteristics of four urbanized basins in south Florida are presented. Land use of the four basins are low-density residential, highway, commercial, and high-density residential. Maps of each basin include a photomosaic, a sewerage map, a drainage map, and an impervious-area map. Tabular data include pervious and impervious areas; sewer data, such as pipe diameter, length, and slope; and inlet elevations. General descriptions of the soil cover and type, vegetation, streets, gutters and curbs are also provided. (Kosco-USGS)  
W80-03486

**WATER RESOURCES DATA FOR NEW HAMPSHIRE AND VERMONT, WATER YEAR 1978,**  
Geological Survey, Boston, MA. Water Resources Div.  
Geological Survey Water-Data Report NH-VT-78-1, October 1979, 199 p, 3 Fig, Append.

Descriptors: \*New Hampshire, \*Vermont, \*Hydrologic data, \*Surface waters, \*Groundwater, Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water-resources data for the 1978 water year for New Hampshire and Vermont consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 83 gaging stations, stage records for 4 lakes, monthend contents for 25 lakes and reservoirs, water-quality data for 7 gaging stations, and water levels for 42 observation wells. Also included are data for 37 crest-stage partial-record stations and 6 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. A few pertinent stations (not included above) in bordering States and Province of Quebec are also included in this report. These data represent that portion of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in New Hampshire and Vermont. (Kosco-USGS)  
W80-03491

**WATER RESOURCES DATA FOR MAINE, WATER YEAR 1978,**  
Geological Survey, Augusta, ME. Water Resources Div.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-122310, Price codes: A11 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ME-78-1, September 1979. 230 p, 3 Fig, 1 Tab.

Descriptors: \*Maine, \*Hydrologic data, \*Surface water, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for Maine consist of records of stage, discharge, and water quality of streams, stage and contents of lakes and reservoirs, and water-levels and water quality of wells. This report contains discharge records for 68 gaging stations, stage only for 2 gaging stations, contents for 17 lakes and reservoirs, water quality for 13 gaging stations and 22 wells, and water levels for 22 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies. (Kosco-USGS)  
W80-03492

**WATER RESOURCES DATA FOR GEORGIA, WATER YEAR 1978,**  
Geological Survey, Doraville, GA. Water Resources Div.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-114622, Price codes: A17 in paper copy, A01 in microfiche. Geological Survey Water-Data Report GA-78-1, September 1979. 384 p, 5 Fig.

Descriptors: \*Georgia, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for Georgia consist of records of stage, discharge, and water quality of streams, and stage and contents of lakes and reservoirs. This report contains discharge records for 101 gaging stations, stage for 10 gaging stations, stage and contents for 16 lakes and reservoirs, water quality for 18 continuous stations and 114 periodic stations, and peak stage and discharge only for 96 crest-stage partial-record stations and 15 miscellaneous sites. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Georgia. (Kosco-USGS)  
W80-03493

**WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1979,**  
Geological Survey, Cheyenne, WY. Water Resources Div.  
D. D. Carlson, and S. L. Green.  
Available from: OFSS, USGS Bx 25425, Fed. Ctr. Denver, CO printed copy \$15.50 microfiche \$3.50, Geological Survey open-file report 79-1278, 1979. 115 p, 11 Fig, 5 Tab.

Descriptors: \*Water resources, \*Surface waters, \*Groundwater, \*Water quality, \*Wyoming, Hydrologic data, Water supply, Streamflow, Flow rates, Sediment transport, Reservoirs, Observation wells, Projects, Publications, Annual, Reviews.

This report contains lists of surface-water stations, ground-water stations, water-quality stations, sediment stations, and peak-flow partial-record stations in Wyoming. The locations of the data-collection sites are shown on maps. Water-resources projects in Wyoming are also described, including many that are related to development of energy resources. The general locations of the projects are shown on maps. The U.S. Geological Survey is striving to coordinate its water-resources investigations with those of other agencies. This report serves as an annual progress report to cooperators and the public. (Kosco-USGS)  
W80-03495

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1978—VOLUME 1. DELAWARE RIVER BASIN,**  
Geological Survey, Harrisburg, PA. Water Resources Div.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-118862,

## Structures—Group 8A

Price codes: A17 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-78-1, September 1979. 374 p, 12 Fig, 4 Tab.

Descriptors: \*Pennsylvania, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, \*Delaware River basin(PA).

Water resources data for the 1978 water year for Pennsylvania consist of records of discharge, and water quality of streams, contents of lakes and reservoirs; and water levels of ground-water wells. This volume contains records for water discharge at 83 gaging stations, contents at 10 lakes and reservoirs, water quality at 59 gaging stations and water levels at 16 observation wells. Also included are data for 43 crest-stage, 35 low-flow, and 44 water-quality partial record stations. Locations of these sites are shown on figures 4 and 5. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 2 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (Kosco-USGS) W80-03496

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1978—VOLUME 2, SUSQUEHANNA AND POTOMAC RIVER BASINS.** Geological Survey, Harrisburg, PA. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-118870. Price codes: A18 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-78-2, June 1979. 411 p, 7 Fig, 1 Tab.

Descriptors: \*Pennsylvania, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, \*Susquehanna River basins(PA), \*Potomac River basins(PA).

Water resources data for 1978 water year for Pennsylvania consist of records of discharge and water quality of streams, contents of lakes and reservoirs, and water levels of ground-water wells. This volume contains records for water discharge at 99 stations, contents at 10 lakes and reservoirs, water quality at 95 gaging stations, and water levels at 29 observation wells. Also included are data for 23 crest-stage, 47 low-flow and 46 water-quality partial-record stations. Locations of these sites are shown on figures 3 and 4. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (Kosco-USGS) W80-03497

**WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1978—VOLUME 3, OHIO RIVER AND ST. LAWRENCE RIVER BASINS.** Geological Survey, Harrisburg, PA. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-118888. Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-78-3, July 1979. 310 p, 5 Fig.

Descriptors: \*Pennsylvania, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, \*Ohio River basin(PA), \*St. Lawrence River basin(PA).

Water resources data for the 1978 water year for Pennsylvania consist of records of discharge and water quality of streams, contents of lakes and reservoirs, and water levels and water quality of ground-water wells. This volume contains records for water discharge at 96 gaging stations, contents at 22 lakes and reservoirs, water quality at 69 gaging stations and 14 wells, and water levels at 25 observation wells. Also included are data for 12 crest-stage, 28 low-flow, and 26 water-quality partial-record stations. Locations of these sites are shown on figures 4 and 5. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 1 and 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (Kosco-USGS) W80-03498

## 8. ENGINEERING WORKS

### 8A. Structures

#### WELL DRILLING FOR +250F WATER,

Oregon Inst. of Tech., Klamath Falls. Geo-Heat Utilization Center.

G. G. Culver. Geo-Heat Utilization Center Quarterly Bulletin, Vol 3, No 1, p 8-10, August, 1977. 1 Fig.

Descriptors: \*Geothermal studies, \*Drilling, \*Shallow wells, \*Heat exchangers, Depth, Heating, Costs, Thermal water.

In most areas, cable tool or rotary drilling rigs that are used for water wells can also be used for geothermal wells. The maximum depth and diameter of the well depends on the size of the rig and the type of formations encountered. Cable tool rigs are generally limited to 3,000 ft. while rotary rigs can go as deep as 3,500 ft. with excellent drilling conditions. Downhole heat exchangers can be installed in a hot water well to meet the heating needs of one or more homes. City water is circulated in the heating loop making a completely closed system. Since no geothermal water is removed from the well, there are no disposal problems. A 500 foot deep, 16 inch diameter well can produce about 2.8 million BTU's per hour without lowering the well temperature. That is enough heat for about 30 average homes. The cost for this well would be about \$25,000 not including the cost of the piping system to distribute the hot water. (Purdin-NWWA) W80-03428

#### APPLICATION OF OPERATIONS RESEARCH TECHNIQUES FOR A PROBLEM IN WATER RESOURCES MANAGEMENT: ECONOMIC APPRAISAL OF CHANGES IN WATER USE INDUCED BY INVESTMENTS INTO NAVIGABLE RIVERS AND CANALS,

Eidgenössische Technische Hochschule, Zurich (Switzerland). Inst. of Operations Research. For primary bibliographic entry see Field 6A. W80-03501

#### VORTEX PROBLEM AT INTAKE, LOWER ST. ANTHONY FALLS LOCK AND DAM, MISSISSIPPI RIVER, MINNEAPOLIS, MINNESOTA; HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. J. H. Ables, Jr. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A072 918. Price codes: A04 in paper copy, A01 in microfiche. Technical Report HL-79-9, May 1979. 69 p, 5 Tab, 19 Photos, 18 Pl.

Descriptors: \*Vortices, \*Intakes, \*Hydraulic models, \*Locks, Dams, Design criteria, \*St. Anthony Falls Lock & Dam(Mississippi River), Minnesota, Minneapolis(Minn).

A 1:25-scale model was used to develop the most feasible and permanent solution to a vortex problem at the Lower St. Anthony Falls Lock Intake on the Mississippi River at Minneapolis, Minnesota. On 10 March 1974, a lock employee in a small boat was accidentally drawn into the vortex and killed. Since then a delayed valve-operating schedule has been used, with a fill time in excess of 14 min, about twice the design fill time; and although the vortex condition is reduced, conditions are not considered satisfactory or safe. Recommended design (type 5) moved the intakes from the top of the upper gate sill and positioned a new intake in the upstream face of the sill, lowered the approach geometry in the approach to the intake ports, lengthened the bull-nose pier between the existing lock and a possible future auxiliary lock and replaced the 7.5-ft-radius nose of the pier with an elliptical nose, added a vortex suppressor across the 56-ft-wide approach, and modified the culvert tainter control valve schedule from 2.07 min to 4.14 and 6.21 min. These modifications to the intake, geometry of the structure, and approach, together with the slower valve schedules, permitted vortex-free lock operation. (WES) W80-03557

#### STABILITY AND STRESS ANALYSES OF BRANDON ROAD DAM, ILLINOIS WATERWAY,

Army Engineer Waterways Experiment Station, Vicksburg, MS. C. E. Pace, and R. L. Campbell. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A064 811. Price codes: A09 in paper copy, A01 in microfiche. Miscellaneous Paper C-78-18, December 1978. 195 p, 9 Fig, 10 Tab, 8 Ref, 2 Append.

Descriptors: \*Dams, \*Stability, \*Stress analysis, Finite element analysis, Design criteria, \*Illinois waterway, \*Brandon Road Dam.

The tainter-gate, sluice-gate, ice-chute, and head-gate monoliths of Brandon Road Dam were analyzed to determine if they meet present-day stability requirements. Stability analyses for the monoliths were performed for these case loadings: (1) normal operation, (2) normal operation plus ice, (3) normal operation plus earthquake, and (4) flood condition. In the analyses of the tainter-gate, sluice-gate, and ice-chute monoliths, the total monolith for each was analyzed and determined to be adequate in stability. However, due to overstress between the main body and the downstream apron of the structures, the aprons of each were considered ineffective and were eliminated from the analyses. Shear stresses in the keys that connect the pier and spillway sections of the tainter-gate monoliths were calculated and found to be less than the allowable 1.1 sq. ft. Therefore, the pier and spillway are considered to act monolithically. In the stability analyses of the tainter-gate, sluice-gate, ice-chute, and head-gate monoliths, results showed the monoliths to be inadequate against overturning stability for all case loadings. The head-gate monoliths were also inadequate for resistance against sliding. To correct these deficiencies, prestressing was recommended and the details are presented for each of the monoliths. (WES) W80-03558

#### FILLING AND EMPTYING SYSTEM, NEW SHIP LOCK, MISSISSIPPI RIVER-GULF OUTLET, LOUISIANA; HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. J. H. Ables, Jr. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A062 074. Price codes: A07 in paper copy, A01 in microfiche. Technical Report H-78-16, September 1978. 100 p, 4 Pho, 43 Pl, 15 Tab, 7 Ref.

Descriptors: \*Locks, \*Hydraulic models, \*Design criteria, Barges, Barge tow tests, \*New Ship Lock(La), \*Mississippi River-Gulf Outlet(La).

Test results of the hydraulic system for the proposed New Ship lock in a 1:25-scale hydraulic

## Field 8—ENGINEERING WORKS

### Group 8A—Structures

model are presented. The original intake and outlet designs which must perform as both intakes and outlets were investigated and found to be satisfactory. Tests of 20 sidewall port manifold arrangements resulted in the recommendation of the type 15 sidewall port manifold arrangement. This arrangement consisted of 20 original design ports (throats 5 by 3.25 ft), spaced 38 ft on centers in each 18.5 by 18.5-ft wall culvert with the ports staggered in opposite walls. For the lock to perform satisfactorily for deep-draft ships, the chamber floor must be constructed at a lower invert elevation than for barge tows. Sufficient ship model input data were presented to permit necessary economic analysis to determine the feasibility of the type 15 (recommended) design manifold port system as developed with some lowering of the chamber floor and manifolds between the miter gates. The type 15 (recommended) design manifold port system as developed is considered optimum for barge tows and satisfactory for ships with proper clearance provided between the bottom of the ships and floor of the lock chamber. (WES) W80-03561

#### OUTLET STRUCTURE FOR MERAMEC LAKE, MERAMEC RIVER, MISSOURI; HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS.

B. P. Fletcher.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A062 109, Price codes: A04 in paper copy, A01 in microfiche. Technical Report H-78-15, October 1978. 59 p, 12 Photos, 30 Pl, 4 Tab.

Descriptors: \*Outlet works, \*Intake structures, \*Hydraulic models, Lakes, Missouri, Design criteria, \*Meramec Lake(Mo).

Model investigation of the outlet works for Meramec Lake was concerned with verification and improvement of the hydraulic performance of the intake structure, transition, conduit, stilling basin, and exit channel. Hydraulic performance of the original and revised outlet works with 22- and 14-ft-wide horseshoe-shaped conduits, respectively, was investigated by means of 1:40- and 1:25.5-scale models. Flow distribution into the stilling basin was improved by providing a 38-ft-long horizontal apron immediately downstream of the 14-ft-wide conduit and placing the sidewalls 1 laterally in 16 longitudinally from the exit portal to the end sill. General discharge characteristics of the outlet works were defined as well as the minimum size and extent of stone protection required in the exit channel immediately downstream of the flared stilling basin. (WES) W80-03563

#### OHIO RIVER BASIN STUDY—COMPREHENSIVE SURVEY: VOLUME XIII-APPENDIX L, NAVIGATION.

Army Engineer Div. Ohio River, Cincinnati.  
For primary bibliographic entry see Field 6B. W80-03370

#### FLOATING-TYPE ANTI-OIL, ANTI-IMPACT AND ANTI-WAVE BARRIER.

Mitsubishi Jukogyo Kabushiki Kaisha, Tokyo (Japan). (Assignee).  
For primary bibliographic entry see Field 5G. W80-03593

### 8B. Hydraulics

PRESENTATION OF LONGITUDINAL DISPERSION DATA, Liverpool Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.  
For primary bibliographic entry see Field 2E. W80-03379

#### SIDE-CHANNEL SPILLWAY AND OUTLET WORKS FOR SAN ANTONIO DAM; HYDRAULIC MODEL INVESTIGATION,

Army Engineer District, Los Angeles, CA.  
D. A. Barela.  
Report No 2-106, October 1978. 56 p, 36 Photos, 12 Pl, 1 Tab, 1 Append.

Descriptors: \*Spillways, \*Outlet works, \*Hydraulic models, Design criteria, Engineering structures, \*San Antonio Dam, \*Side-channel spillways.

Model studies of proposed uncontrolled side-channel spillway and outlet works for San Antonio Dam were conducted to develop, by means of 1:36- and 1:48-scale models of the spillway and a 1:20-scale model of the outlet works, satisfactory and economical designs for these elements. Particular attention was given to flow characteristics in the side channel, spillway chute, and flip bucket for side-channel spillway and to performance of the intake structure, outlet conduit, and diversion structure for the outlet works. Although the spillway crest functioned satisfactorily as originally designed, excessive ride-up and turbulence in the side channel during maximum design flow of 34,000 cfs indicated need for improved performance of the channel. Addition of baffle blocks on side-channel invert provided adequate control of flow and reduced excessive ride-up occurring in the channel. Flow in the spillway chute was more stable and less turbulent. Tests of the intake structure and outlet circular conduit disclosed flow conditions were acceptable. Results revealed for a discharge of 1,000 cfs, performance of the diversion structure was satisfactory. Measured discharge to each part of the spreading grounds agreed with design assumptions. As flow in the outlet conduit was increased, however, disturbance at entrance to chamber became more pronounced. (WES) W80-03394

#### SOUTH JETTY STABILITY STUDY, MASONBORO INLET, NORTH CAROLINA; HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS.  
R. D. Carver, and D. G. Markle.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A062 132, Price codes: A03 in paper copy, A01 in microfiche. Miscellaneous Paper H-78-12, October 1978. 41 p, 22 Photos, 6 Pl, 7 Ref.

Descriptors: \*Jetty, \*Stability, Model studies, Design criteria, Hydraulic models, \*Coastal structures, \*Breakwaters, North Carolina, \*Armor units(Hydraulics), \*Masonboro Inlet(NC).

Hydraulic model flume tests were conducted to investigate the stability response of a jetty cross section proposed for the South Jetty, Masonboro Inlet, North Carolina. The original design (Plan I) was not stable, and three additional designs were tested in an effort to find a satisfactory solution. All designs tested consist of one layer of armor stone subjected to breaking wave conditions. None of the designs were completely stable for all the designated storm conditions, and sufficient funds were not available to further the investigation. Based on the tests conducted, results show that all the designs were stable for storm conditions at the 8.5 ft mllw swl, but none of the designs were stable for storm conditions at the 12.5 ft mllw swl. Thus, whether the designs tested meet the no-damage criteria depends upon the selection of the design storm condition. (WES) W80-03397

#### THE EFFECT OF SALINITY ON GEOTHERMAL WELL PERFORMANCE,

California Univ., Livermore. Lawrence Livermore Lab.  
J. Z. Grens.  
Available from the National Technical Information Service, Springfield, VA 22161 as UCID-16791, Price codes: A02 in paper copy, A01 in microfiche. Report UCID-16791, May 14, 1975. 14 p, 5 Fig, 2 Tab, 13 Ref.

Descriptors: \*Geothermal studies, \*Salinity, \*Wells, \*Performance, Productivity, Energy loss, Brines, Density, Viscosity, Vapor pressure, Thermal capacity, Enthalpy, Entropy, Flow resistance.

As the salinity of geothermal brines increases, changes occur in physical and thermodynamic properties which strongly affect the energy content and availability of the brines and the performance of the producing wells. In a typical well flowing at 500 lb/sq.ft/sec. pressure losses are distributed roughly 1/4 to formation breakdown, 1/4 to friction, and 1/2 to hydrostatic loss. The higher density and lower vapor pressure which accompany increasing salinity both tend to add to the hydrostatic gradient in the flowing well. Two phase flow effects in the well bore add a few percent to the hydrostatic gradient. Energy yield is reduced due to low enthalpy of brines and decreased well flow. Each 1% dissolved solids reduces available energy by 0.8 to 0.9% compared to distilled water at the same temperature and pressure. The distribution of pressure losses will vary with formation properties, in situ conditions and well parameters. (Purdin-NWNA) W80-03430

#### HEAD-LOSS MEASUREMENTS ON HYDRO-ELECTRIC CONDUITS,

Hydro-Electric Commission of Tasmania, Hobart (Australia).  
T. M. Brett.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY1, Proceedings Paper 15109, p 173-190, January 1980. 6 Fig, 8 Tab, 11 Ref, 2 Append.

Descriptors: \*Tunnel linings, \*Canal design, \*Australia, Hydroelectric plants, \*Head loss, Penstocks, \*Pipe flow, Pipelines, Hydraulics, Friction, Algae, Aquatic plants, \*Hydroelectric conduits, Friction coefficient(Hydraulic), Power generation, Power.

Prototype head-loss measurements on tunnels and other water conduits were reported. The measurements were done on water-power conduits of the Hydro-Electric Commission of Tasmania, Australia. Friction factors are given for an unlined tunnel, a mechanically bored partly lined tunnel, and a fully lined tunnel. Steel and woodstave friction factors were included together with factors for a concrete-lined trapezoidal canal. The effect of slime growth on head losses was discussed. (Lee-ISWS) W80-03453

#### FLOW PAST FENCE IN TURBULENT BOUNDARY LAYER,

Roorkee Univ. (India). Dept. of Civil Engineering.  
P. K. Pande, R. Prakash, and M. L. Agarwal.  
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY1, Proceedings Paper 15151, p 191-207, January 1980. 14 Fig, 1 Tab, 24 Ref, 2 Append.

Descriptors: \*Turbulent boundary layers, \*Flow around objects, \*Flow separation, \*Model studies, Mathematical models, Hydraulic models, Boundary layers, Flow rates, Turbulent flow, Friction, Flow friction, Fluid friction, Bubbles, Hydraulics, Fences.

The flow past a fence submerged in a turbulent boundary layer was studied experimentally. The characteristics of the flow both upstream and downstream of the fence were presented. The variation of boundary layer parameters, velocities, turbulence intensities, and skin friction were reported. The sizes of the upstream and downstream separation bubbles were also correlated with relevant parameters. The results were also compared with the numerical solution of momentum and energy integral equations for the approach boundary layer. (Sims-ISWS) W80-03454

#### FEASIBILITY STUDY OF A NUMERICAL TOW MODEL,

Army Engineer Waterways Experiment Station, Vicksburg, MS.  
T. D. Ankeny, C. J. Huval, and L. L. Daggett.  
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A062 727, Price codes: A04 in paper copy, A01 in microfiche. Miscellaneous Paper H-78-11, September 1978. 52

## Soil Mechanics—Group 8D

p, 11 Tab, 12 Ref, 2 Append.

Descriptors: \*Barges, \*Mathematical models, \*Feasibility, Transportation, Locks, Dams, Barge tow, \*Towboats, Tows and towing, Ship maneuverability.

Explores the feasibility of developing a numerical hydrodynamic model of a typical push towboat-barge combination for use in engineering planning and design studies. Such a model might be used to simulate tow movements in restricted waterways in critical river reaches such as bends, bridges, and near navigation locks and dams to determine the adequacy and/or economic efficiency of channel designs. No information was available at the beginning of this study on numerical models of tow hydrodynamics or on towing tank or prototype tests of the maneuverability of tows. During the study several numerical models did become available, and this work is described. Since no information was available for the development or testing of a numerical tow maneuvering model, a series of measurements were made of radio-controlled scale model tows used in physical model studies involved in standard ship hydrodynamic maneuvers. Data from these measurements and computations were used to determine estimates of hydrodynamic coefficients of a linear model of ship maneuverability. Findings show tow maneuvers can be predicted by a numerical model of tow maneuverability; however, additional measurements of tow response characteristics are required before a model useful in engineering studies can be developed. (WES) W80-03562

## 8C. Hydraulic Machinery

**SHAFT TORSIONAL OSCILLATIONS OF HYDROGENERATORS,**  
Bureau of Reclamation, Denver, CO. Engineering and Research Center.  
L. E. Eilts, and E. Campbell.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-102155. Price codes: A03 in paper copy, A01 in microfiche. Report No REC-ERC-79-6, August 1979. 30 p, 16 Fig, 1 Tab, 2 Append.

Descriptors: \*Hydroelectric plants, \*Generators, \*Electric generators, \*Strain gages, Analog computers, Elasticity(Mechanical), Dynamics, Instrumentation, Resonance, Prototype tests, Model studies, Torsion, Turbines, Motor generators, Oscillation.

Shaft torsional oscillations of electrical generators are analyzed, modeled, and instrumented to study the torsional behavior of hydrogenerators and the effect of high-initial-response static excitation systems on damping of torsional oscillations. Block diagram and analog computer models were developed from mathematical equations modelling shaft torsional phenomena. Data calculated from several Bureau of Reclamation hydrogenerators are included. A single shaft torsional oscillation mode generally characterizes hydrogenerators. This oscillation mode is adequately damped due to viscous waterwheel damping. Results of tests at the Grand Coulee Powerplant show that hydrogenerator excitation systems have negligible effect on shaft torsional oscillations due to the large inertia of hydrogenerator rotors. An instrumentation system was developed for prototype field measurements. The system uses shaft-mounted strain gages to provide a torsional signal. The system was used to obtain shaft torsional oscillations data from three units and these data are presented along with the design and circuit configuration of the system. The information given is specifically applicable to hydrogenerators but is equally applicable to other types of generators. (Seigler-IPA) W80-03515

**ELECTRONIC FILTER LEVEL OFFSET (EL-FLO) PLUS RESET EQUIPMENT FOR AUTOMATIC DOWNSTREAM CONTROL OF CANALS,**  
Bureau of Reclamation, Denver, CO. Engineering and Research Center.

C. P. Buyalaki, and E. A. Serfoso.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-104003. Price codes: A07 in paper copy, A01 in microfiche. Report No REC-ERC-79-3, June 1979. 151 p, 53 Fig, 20 Tab, 7 Ref, 6 Append.

Descriptors: \*Canals, \*Automatic control, \*Irrigation canals, \*Analog models, Analog computers, Mathematical models, Laboratory tests, Model studies, Water management(Applied), Water levels, Flow, Hydraulics, California, Arizona, Filters.

To upgrade the operation and efficiency of canal systems an automatic integrated circuit system of downstream control of canal gates was developed. The control mechanism, an analog computer controlled electronic filter level offset (EL-FLO) plus RESET was mathematically modeled, designed, constructed, and tested. The control system can handle complex irrigation water delivery schedules while maintaining nearly constant water levels in a canal system. An electronic time delay replaces the cumbersome hydraulic filter to eliminate the inherent sustained water level oscillations for automatic flow regulation systems. The RESET controller eliminates the residual water offset associated with proportional control. Laboratory simulation tests were performed to confirm that the control system was designed and built as modeled and to test equipment performance at high temperatures and high humidity. Field tests of the control system conducted at the South Gila Canal in Arizona and the Corning Canal in California verified the accuracy of the systems' response characteristics. Following the positive testing results EL-FLO plus RESET specifications were written and 21 units were permanently installed in California on the Coring and Coalina Canals. Extensive test result data are included. (Seigler-IPA) W80-03387

**TWENTY YEARS OF EXPERIENCE WITH WELL-WATER-SOURCE HEAT PUMPS AT BATTELLE'S COLUMBUS LABORATORIES,**  
Battelle Columbus Lab., OH.

R. D. Fischer, C. F. Holt, S. G. Talbert, and T. E. Maloy.  
Paper presented at the 4th Annual Heat-Pump Technology Conference, Oklahoma State University, Stillwater, Oklahoma, April 9-10, 1979. 8 p, 4 Fig, 1 Tab, 3 Ref.

Descriptors: \*Heat pumps, \*Ground water, Well spacing, Safe yield, Pumping, Cost comparisons, Operating costs, Heating, Cooling, Maintenance, Shallow wells, Scaling.

Two similar heat pumps, installed 20 years ago, are still providing primary comfort-conditioning needs of four laboratory and office buildings with a total floor area of approximately 320,000 sq. ft. These systems use as a heat source, ground water from five shallow wells in sand and gravel of the Olentangy River flood plain. The maximum safe yield of the well field is 1400 gpm. The cost of heating with four conventional fuels is compared with that for the ground water heat pump. The heat pump costs slightly less than coal and natural gas. The coefficient of performance of the heat pump system is 4.4 which means that 4.4 times as much energy is obtained from the system as is put into it. Monthly well-water consumption and electric power consumption of the compressor motors are given for 13 years. Yearly maintenance procedures, operational problems that were solved, and future plans are discussed. (Purdin-NWWA) W80-03425

**SELECTION AND DESIGN OF INJECTOR PUMP SYSTEMS,**  
J. Rossetti.  
Canadian Water Well, Vol 5, No 3, p 28, 30, August, 1979. 4 Fig.

Descriptors: \*Pumps, \*Design criteria, Storage tanks, Pipes, Water wells, Deep-well pumping, Water delivery, Water utilization.

The design and selection of shallow (+25 ft.) and deep (+60 ft.) well injector pumps are discussed.

Selection of the proper injector pump depends on: (1) inside diameter of well; (2) depth of well; (3) pumping water level; (4) capacity of well; (5) capacity and pressure requirements of the system. Selection would be made from pump performance tables. In some cases, where the inside diameter of a deep well is too small for a parallel pipe injector, an inner pipe injector can be used. Single stage shallow well injector pumps should be capable of pressures of 30 to 50 psi. For higher operating pressures, multi-stage shallow well injector pumps are available with discharge pressures up to 110 psi. Most deep and shallow well water systems use plastic pipe due to its low cost, reduced friction loss, and low installation cost. However, the grade of pipe must be strong enough to withstand the pressure. Pre-charged pressure tanks deliver more water between cycles but tankless water systems with constant pressure are growing in popularity. To protect the system from freezing, pipes must be buried deep enough and pumps should be heated. A good system will include a gate valve between the pump and tank and a priming tee. (Purdin-NWWA) W80-03429

**DOWNHOLE PUMPS FOR WATER SAMPLING IN SMALL-DIAMETER WELLS,**  
Geological Survey, NSTL Station, MS. Water Resources Div.

F. C. Koopman.  
Available from OFSS, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Price codes: \$8.50 in paper copy, \$3.50 in microfiche. Geological Survey open-file report 79-1264, 1979. 61 p, 1 Fig, 5 Tab.

Descriptors: \*Pumps, \*Groundwater, \*Sampling, \*Water wells, \*Methodology, Deep-well pumping, Specifications, Equipment, Design, Performance, \*Small-diameter wells.

The relatively high cost and difficulty in locating a source of pumps for use in obtaining ground-water samples from small-diameter wells has demonstrated a need for this report. Criteria for selection of a pump and pumping equipment to meet specific requirements has been tabulated to assist field personnel in making a selection from commercial sources. (Kosco-USGS) W80-03483

## 8D. Soil Mechanics

**LABORATORY PROCEDURES FOR DETERMINING THE DISPERSIBILITY OF CLAYEY SOILS,**  
Bureau of Reclamation, Denver, CO. Engineering and Research Center.  
J. L. Kenney.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-301 097. Price codes: A03 in paper copy, A01 in microfiche. Report No REC-ERC-79-10, September 1979. 24 p, 12 Fig, 4 Tab, 26 Ref, 1 Append.

Descriptors: \*Clays, \*Soil tests, \*Dispersion, \*Soil analysis, \*Hydrometers, \*Erosion rates, Chemical analysis, Laboratory tests, Cation adsorption, Cations, Soil texture, Soil aggregates, Soil types, Turbidity, Chemical analysis, Instrumentation.

Procedures for the following dispersive clays tests are described: the pinhole test, chemical analyses, double hydrometer test, and the crumb test. All four tests are used to measure the potential dispersibility or erodibility of clayey soils which are difficult to distinguish from nonerodible clays by conventional index tests. For the pinhole test five equal lifts of sample soil totaling 38 mm in height are molded and allowed to stabilize for 16 hours in a sealed cylinder. A truncated brass cone is pushed into the upstream end of the sample and a 1 mm-diameter hypodermic needle is pushed through the entire sample to produce the 'pinhole'. After adding screens and glass spheres, the sample is placed horizontally and distilled water under a 50 mm hydrostatic head is passed through the sample. Results from this flow are used along with electrical conductivity, turbidity, and pH to measure the

## Field 8—ENGINEERING WORKS

### Group 8D—Soil Mechanics

dispersibility of the sample. Chemical testing procedures are used to identify potentially dispersive clays by isolating and identifying soluble water cations and anions adhering to clay particle surfaces. The crumb test or aggregate coherence test involves the timed hydrating or crumbling of a 15 mm cube of soil in 250 ml of distilled water. For the double hydrometer test two identical 200 g samples are used. One sample is subjected to standard gradation analysis while the other is dried, rehydrated, desired and then measured. (Seigler-IPA)

W80-03316

### 8I. Fisheries Engineering

INVESTIGATIONS INTO THE EFFECTS OF VOLUME OF WATER FLOW, QUALITY OF FEED AND TYPE OF FEEDING ON THE PRODUCTION OF THE AISCHGRUND COMMON CARP, CYPRINUS CARPIO, IN CIRCULAR CONCRETE PONDS UNDER HIGH STOCKING DENSITY RATES,

Lowveld Fisheries Research Station, Marble Hall (South Africa).

F. D. W. Brandt, and H. J. Schoonbee.

Water SA, Vol 5, No 4, p 171-177, October 1979. 2 Fig, 5 Tab, 14 Ref.

Descriptors: \*Carp, \*Proteins, \*Fish diets, \*Fish farming, \*Fish populations, Fish harvest, Fish stocking, Fisheries, Flow, Concrete structures, Irrigation water, Water reuse, Density, Oxygenation, Ponds, Agriculture.

Changes in protein content of pelleted fish feed and changes in water flow were tested during the summers of 1974 through 1976 as means of increasing fish production and conserving water in the growth of fish at the Lowveld Fisheries Research Station at Marble Hall, South Africa. Due to the shortage of water in the area and its demand for irrigation, water is used first for fish production and then for irrigation. The fish used for the tests was the Aischgrund common carp, Cyprinus carpio, which was imported from Germany. The fish were grown in circular concrete ponds having a capacity of 16.1 cu m and in water transported by canal from the Loskop Dam Irrigation Scheme. To test protein content of feeds the ponds were stocked with 1000 carp fingerlings each for a density of 62/cu m of pond water. Types of feed tested were trout pellets with 42% protein and carp pellets with 25% protein. Some ponds were fed by hand and some were equipped with a demand feeder. Results show that the 42% protein pellet was superior to the 25% protein pellet for production of fish at high densities. Pond water flow effects on production were also tested by regulating flow by 1, 2, or 3 liters. Ponds were again stocked at 62/cu m density. Flow regulation results show that a slight increase in flow results in a major improvement in production capacity for the type of concrete pond and stocking density tested. (Seigler-IPA)

W80-03323

## 10. SCIENTIFIC AND TECHNICAL INFORMATION

### 10D. Specialized Information Center Services

A TECHNOLOGY TRANSFER STUDY OF WATER RESOURCES: A SOUTH CAROLINA EXPERIENCE,

Clemson Univ., SC. Dept. of Political Science. H. E. Albert.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-149966. Price codes: A05 in paper copy, A01 in microfiche. Prepared for the South Carolina Water Resources Commission, July 1979. 74 p, 14 Fig. OWRT T-0020 (7705)(1).

Descriptors: \*South Carolina, \*Technology, \*Groundwater, \*Information exchange, Publications, Data collections, Research and development,

Organizations, Administration, Water conservation, Education, Training, Brochures, Technology transfer.

Technology-transfer techniques used by the South Carolina Water Resources Commission (SCWRC) are examined with emphasis on the transfer of groundwater technology. Two basic groups of SCWRC information users are decision makers such as government officials or private industry and doers such as consulting engineers and well drilling contractors. A one year project is described that was designed to: (1) discover the state-of-the-art in technology transfer, (2) conduct seminars and workshops to transfer technology to users, and (3) develop a mailing list of potential users and a newsletter to lead to the establishment of a clearinghouse for recently developed technology. Interviews were conducted with various researchers to determine what research was being done, who was sponsoring it, what technology they hoped to develop, and who the expected users were. Groundwater investigations in the Lowcountry and in Horry, Georgetown, and Marion Counties were used as technology transfer demonstration projects. An existing mailing list for the newsletter, Palmetto Waters was expanded but is still disorganized and needs further attention. It is concluded that the SCWRC does an outstanding job of research and technology transfer given the constraints of its budget. Copies of several information bulletins are included. (Seigler-IPA)

W80-03384

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- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
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A32	33.00	E32	66.50	T32	1,980.00
A33	34.00	E33	68.50	T33	2,040.00
A34	35.00	E34	70.50	T34	2,100.00
A35	36.00	E35	72.50	T35	2,160.00
A36	37.00	E36	74.50	T36	2,220.00
A37	38.00	E37	76.50	T37	2,280.00
A38	39.00	E38	78.50	T38	2,340.00
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A45	46.00	E45	92.50	T45	2,760.00
A46	47.00	E46	94.50	T46	2,820.00
A47	48.00	E47	96.50	T47	2,880.00
A48	49.00	E48	98.50	T48	2,940.00
A49	50.00	E49	100.50	T49	3,000.00
A50	51.00	E50	102.50	T50	3,060.00
A51	52.00	E51	104.50	T51	3,120.00
A52	53.00	E52	106.50	T52	3,180.00
A53	54.00	E53	108.50	T53	3,240.00
A54	55.00	E54	110.50	T54	3,300.00
A55	56.00	E55	112.50	T55	3,360.00
A56	57.00	E56	114.50	T56	3,420.00
A57	58.00	E57	116.50	T57	3,480.00
A58	59.00	E58	118.50	T58	3,540.00
A59	60.00	E59	120.50	T59	3,600.00
A60	61.00	E60	122.50	T60	3,660.00
A61	62.00	E61	124.50	T61	3,720.00
A62	63.00	E62	126.50	T62	3,780.00
A63	64.00	E63	128.50	T63	3,840.00
A64	65.00	E64	130.50	T64	3,900.00
A65	66.00	E65	132.50	T65	3,960.00
A66	67.00	E66	134.50	T66	4,020.00
A67	68.00	E67	136.50	T67	4,080.00
A68	69.00	E68	138.50	T68	4,140.00
A69	70.00	E69	140.50	T69	4,200.00
A70	71.00	E70	142.50	T70	4,260.00
A71	72.00	E71	144.50	T71	4,320.00
A72	73.00	E72	146.50	T72	4,380.00
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A76	77.00	E76	154.50	T76	4,620.00
A77	78.00	E77	156.50	T77	4,680.00
A78	79.00	E78	158.50	T78	4,740.00
A79	80.00	E79	160.50	T79	4,800.00
A80	81.00	E80	162.50	T80	4,860.00
A81	82.00	E81	164.50	T81	4,920.00
A82	83.00	E82	166.50	T82	4,980.00
A83	84.00	E83	168.50	T83	5,040.00
A84	85.00	E84	170.50	T84	5,100.00
A85	86.00	E85	172.50	T85	5,160.00
A86	87.00	E86	174.50	T86	5,220.00
A87	88.00	E87	176.50	T87	5,280.00
A88	89.00	E88	178.50	T88	5,340.00
A89	90.00	E89	180.50	T89	5,400.00
A90	91.00	E90	182.50	T90	5,460.00
A91	92.00	E91	184.50	T91	5,520.00
A92	93.00	E92	186.50	T92	5,580.00
A93	94.00	E93	188.50	T93	5,640.00
A94	95.00	E94	190.50	T94	5,700.00
A95	96.00	E95	192.50	T95	5,760.00
A96	97.00	E96	194.50	T96	5,820.00
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